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UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF LOUISIANA

IN RE: OIL SPILL BY THE DOCKET NO. MDL-2179
OIL RIG *DEEPWATER HORIZON* SECTION "J"
IN THE GULF OF MEXICO ON NEW ORLEANS, LA
APRIL 20, 2010 TUESDAY, OCTOBER 15, 2013

IN RE: THE COMPLAINT AND DOCKET NO. 10-CV-2771
PETITION OF TRITON ASSET SECTION "J"
LEASING GMBH, ET AL

UNITED STATES OF AMERICA DOCKET NO. 10-CV-4536
V. SECTION "J"
BP EXPLORATION & PRODUCTION,
INC., ET AL

DAY 9 AFTERNOON SESSION
TRANSCRIPT OF NONJURY TRIAL PROCEEDINGS
HEARD BEFORE THE HONORABLE CARL J. BARBIER
UNITED STATES DISTRICT JUDGE

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P-R-O-C-E-E-D-I-N-G-S

TUESDAY, OCTOBER 15, 2013

A F T E R N O O N S E S S I O N

(COURT CALLED TO ORDER)

01:20:14 7 THE DEPUTY CLERK: All rise.

01:20:15 8 THE COURT: All right. Please be seated, everyone.

01:20:24 9 All right. Mr. Fields, you may resume your
01:20:27 10 direct.

01:20:30 11 MR. FIELDS: Thank you, Your Honor.

01:20:31 12 One housekeeping matter, if you don't mind.

01:20:31 13 THE COURT: Sure.

01:20:32 14 MR. FIELDS: The Court, obviously, reviewed the video
01:20:36 15 deposition excerpts from Jaime Loos. At this point, we would
01:20:39 16 like to offer those into evidence.

01:20:41 17 THE COURT: Any objections?

01:20:42 18 MS. HIMMELHOCH: No, Your Honor.

01:20:43 19 THE COURT: Without objection, those are admitted.

01:20:43 20 **ROBERT W. ZIMMERMAN, Ph.D.,**

01:20:43 21 was called as a witness and, after being previously duly
01:20:43 22 sworn by the Clerk, was examined and testified on his oath
01:20:49 23 as follows:

01:20:49 24 DIRECT EXAMINATION BY MR. FIELDS:

01:20:52 25 Q. Professor Zimmerman, before we broke for lunch, we were

01:20:54 1 getting ready to talk about the third test you considered in
01:20:56 2 reaching your opinions about the rock compressibility of
01:20:59 3 Macondo. That test was called the acoustic velocity test?

01:21:04 4 A. Yes, I think it's also sometimes called the ultrasonic
01:21:08 5 velocity test.

01:21:10 6 Q. Who conducted this ultrasonic velocity or acoustic
01:21:14 7 velocity test?

01:21:14 8 A. This test was also conducted by Weatherford Laboratories.

01:21:18 9 Q. On how many samples was the acoustic velocity or
01:21:22 10 ultrasonic velocity test performed?

01:21:25 11 A. These tests were performed on three samples. They were
01:21:31 12 different samples than the ones used in the two previously
01:21:34 13 discussed tests.

01:21:36 14 As I mentioned briefly earlier, the tests were only
01:21:39 15 fully conducted on two of those three samples.

01:21:45 16 Q. Would you please display D-3702. This is a demonstrative
01:21:57 17 to hopefully help us understand what the acoustic or ultrasonic
01:21:59 18 velocity test is.

01:22:00 19 Can you sort of explain to the Court how the test
01:22:02 20 works in general.

01:22:03 21 A. Well, essentially, these are tests to measure how fast
01:22:06 22 sound waves travel through the rock. In this schematic here,
01:22:11 23 it shows a typical rock core, and there are two metallic
01:22:17 24 transducers on the top and the bottom. Inside those
01:22:21 25 transducers are little crystals that have a special property

01:22:22 1 such that when an electrical current passes through the
01:22:26 2 crystal, it's induces a vibration.

01:22:27 3 So one sends an electrical current into the upper
01:22:30 4 transducer. It creates a vibration in that crystal, which then
01:22:33 5 that vibration, essentially a sound wave, gets transmitted to
01:22:37 6 the rock, travels to the rock through the bottom transducer,
01:22:42 7 which acts as a receiver.

01:22:43 8 In that way, one can measure the time that it takes
01:22:47 9 for the sound wave to travel through the rock, one can easily
01:22:51 10 measure the length of that rock, and, from those two pieces of
01:22:55 11 information, calculate the speed that the wave travels through
01:22:58 12 the rock.

01:22:58 13 I should point out that whereas in a liquid or a gas
01:23:04 14 such as air, there is only one type of wave that travels. In a
01:23:09 15 solid material such as a rock, there are two different types of
01:23:12 16 waves called P waves and S waves.

01:23:15 17 So in this test, both of those types of waves can
01:23:18 18 be -- the velocity of those two types of waves can be measured.

01:23:22 19 Q. Why don't we pull up TREX-9056.9.1.

01:23:30 20 Is this an excerpt of the report containing the
01:23:33 21 Weatherford acoustic velocity test results that you relied upon
01:23:39 22 in forming your opinions in this case?

01:23:41 23 A. Yes, it is.

01:23:42 24 Q. Sort of help us understand what some of this data is.

01:23:44 25 A. Well, in the farthest-most left column is just an

01:23:49 1 indication of the sample number. The next column shows the
01:23:52 2 depth at which that core was taken.

01:23:55 3 Now, the most pertinent information for our purposes
01:23:58 4 are in the middle panel here, ultrasonic wave velocities. This
01:24:04 5 compressional wave is what I referred to earlier as a P wave.
01:24:08 6 It's also known as the P wave. This shear wave is what I also
01:24:12 7 are referred to earlier as the S wave.

01:24:15 8 So in this column here shows the velocity, so-called
01:24:19 9 P wave velocity in units of feet per second. This column here
01:24:24 10 shows the S wave velocity in units of feet per second.

01:24:28 11 As you see, the P wave velocities for all three of
01:24:31 12 these cores were measured. The S wave velocities were only
01:24:36 13 measured on two of those cores, and so I only used those two
01:24:40 14 cores to conduct my further analysis.

01:24:40 15 Q. So to conduct your analysis, did you need data for both
01:24:45 16 compressional wave velocity as well as shear wave velocity?

01:24:49 17 A. That's right. In order to convert this data into a bulk
01:24:58 18 compressibility, one needs to know both the compressional
01:25:01 19 velocity and the shear velocity.

01:25:02 20 Q. Can you explain for us or will you explain for us how you
01:25:04 21 went about converting these ultrasonic wave velocities into the
01:25:12 22 UPVC value?

01:25:13 23 A. Well, the first step of this procedure is to note that
01:25:16 24 there is a very well-known relationship that expresses these
01:25:25 25 velocities in terms of the elastic stiffnesses and the density

01:25:29 1 of the material.

01:25:30 2 In particular, there is something called the bulk
01:25:33 3 modulus. The bulk modulus is just the mathematical inverse of
01:25:37 4 the bulk compressibility, so it's one divided by the bulk
01:25:37 5 compressibility.

01:25:40 6 The compressional wave speed and the shear wave speed
01:25:46 7 are given exactly by known equations in terms of these elastic
01:25:52 8 moduli and densities.

01:25:53 9 So without going into details, the details of which
01:25:55 10 are given in my report, if one has numerical values for the
01:25:59 11 compressional wave speed and the shear wave speed, and if you
01:26:02 12 know the density of the rock -- and you see that the density of
01:26:06 13 the rock is, in fact, reported in the fourth column -- one can
01:26:09 14 easily calculate all the relevant elastic moduli.

01:26:12 15 The one that's of most pertinence to us here is
01:26:16 16 something called bulk modulus, which is exactly equal to one
01:26:19 17 divided by the bulk compressibility.

01:26:22 18 So that part of the calculation, which is, in fact,
01:26:26 19 already done here by Weatherford, although I repeated the
01:26:30 20 calculation to verify, it's a simple calculation, so one now
01:26:33 21 has the bulk compressibilities. One can then use some of the
01:26:38 22 equations -- that I think I alluded to earlier, but, in any
01:26:42 23 rate, are given in my report in detail -- and these
01:26:44 24 relationships to convert the bulk compressibility into a
01:26:50 25 pore compressibility.

01:26:50 1 So I used those relations to convert to a
01:26:54 2 pore compressibility. Specifically, it's, again, a two-stage
01:26:57 3 process. You first convert the bulk compressibility to a
01:27:00 4 hydrostatic pore compressibility. Then one can convert to a
01:27:04 5 uniaxial pore compressibility.

01:27:05 6 Q. How did you convert from the hydrostatic pore volume
01:27:12 7 compressibility to the uniaxial pore volume compressibility,
01:27:13 8 which is most relevant to this case?

01:27:16 9 A. Well, that, again, it's done from a known equation. To do
01:27:21 10 that conversion, one needs to know various parameters such as
01:27:26 11 the mineral compressibility, which is easily calculated. One
01:27:30 12 also needs to know something called the Poisson ratio, which is
01:27:34 13 another elastic parameter.

01:27:36 14 As we see here, the Poisson ratio is, in fact,
01:27:39 15 measured in these tests. So one can use these values of a
01:27:43 16 Poisson ratio to carry out that conversion.

01:27:45 17 Q. Would you please display D-24653.

01:27:57 18 Professor Zimmerman, what was the estimate of UPVC
01:28:00 19 that you arrived at using this acoustic velocity data from the
01:28:06 20 Weatherford tests?

01:28:09 21 A. Well, as one sees here, the value that I arrived at was
01:28:13 22 four microsips. Maybe we should step back a bit. I should
01:28:16 23 point out that there's one more step in this calculation, and
01:28:18 24 that is the step that's required to convert these
01:28:22 25 compressibilities that are measured during dynamic processes,

01:28:26 1 such as wave provocation, to compressibilities that are
01:28:30 2 relevant to relatively slowly evolving processes, such as
01:28:34 3 depletion of oil from a reservoir.

01:28:36 4 It is well known that rocks are generally -- have a
01:28:41 5 lower sort of dynamic compressibility than a static
01:28:47 6 compressibility, so the last step in the analysis process is to
01:28:50 7 look -- in particular, I used a known correlation that was
01:28:53 8 developed by a Professor Amos Nur at Stanford University that
01:28:57 9 allows one to convert the dynamically derived compressibility
01:29:02 10 to the static compressibility. I should point out that, in
01:29:05 11 fact, the dynamic compressibility is lower.

01:29:09 12 So there's another -- one calls it correction factor,
01:29:12 13 or another factor that I put into my analysis, which actually
01:29:15 14 increases the compressibility that one obtains from this
01:29:20 15 dynamic test to give you a value that would pertain to a slowly
01:29:24 16 evolving process such as oil being depleted from a reservoir.

01:29:28 17 The final result of all of those calculations is a
01:29:31 18 value of about four microsips.

01:29:33 19 Q. How, in your view, does the results that you obtained from
01:29:39 20 using the acoustic velocity test compare to the results that
01:29:43 21 you obtained from the uniaxial compression test?

01:29:47 22 A. Well, the numerical value is actually a bit lower.

01:29:50 23 As I think I mentioned earlier, since the uniaxial
01:29:57 24 compression test is the test that most directly measures the
01:29:59 25 parameter that we're interested in, I consider that to be the

01:30:02 1 most accurate of these tests. So I used that as the basis for
01:30:08 2 my estimate of 6.35 microsips.

01:30:11 3 I used this data in the same way that I used the data
01:30:14 4 from the hydrostatic stair-step test, to essentially see if it
01:30:21 5 was grossly out of line with the value from the uniaxial test.
01:30:26 6 If it were much, much larger, for example, then that would have
01:30:30 7 given me pause to think that perhaps there might be something
01:30:33 8 wrong with the uniaxial test; but, in fact, it doesn't give a
01:30:37 9 grossly different value. In particular, it actually gives a
01:30:41 10 lower value.

01:30:41 11 So, certainly, another point that could be made based
01:30:43 12 on this data, it certainly provides no evidence at all that the
01:30:49 13 actual compressibility was appreciably higher than
01:30:52 14 6.35 microsips.

01:30:52 15 Q. Let's turn to a slightly different topic. During opening
01:30:59 16 statement Mr. Brock mentioned a concept called isotropy or
01:31:06 17 anisotropy as it relates to rock properties, so I wanted to
01:31:09 18 discuss this particular concept briefly.

01:31:10 19 Do you have the sandstone demonstrative up there? I
01:31:13 20 think that's D-23958. We looked earlier at the rotary
01:31:21 21 sidewall core tool, and we saw how the tool extracts the core
01:31:26 22 out of the sidewall.

01:31:27 23 Can you explain the relevance of that, if any, to the
01:31:31 24 concept or phenomenon called anisotropy?

01:31:37 25 Or maybe we should step back. What is anisotropy

01:31:38 1 first?

01:31:39 2 A. Well, if it's okay with you'll, I'll step back even one
01:31:43 3 step further. An isotropy is the general term for a situation
01:31:45 4 in which the properties of a material are the same regardless
01:31:49 5 of what direction they are measured in.

01:31:50 6 So for example, again, going back to steel as a very
01:31:54 7 simple material which is isotropic, if one measured the
01:31:58 8 compressibility of steel in this direction or in a different
01:32:02 9 direction, one would get the same value, and that type of
01:32:05 10 material would be called isotropic.

01:32:09 11 Anisotropy is the general term used for situations in
01:32:12 12 which the physical properties that you measure might have
01:32:14 13 different values depending on which direction they are measured
01:32:16 14 in.

01:32:16 15 So this is an issue that needs to be thought about.
01:32:21 16 The reason that it's particularly relevant in the case, if I
01:32:25 17 can continue, is, as I mentioned earlier, in the reservoir, the
01:32:31 18 compression occurs in the vertical direction. However, the
01:32:34 19 rotary sidewall core is extracted horizontally off to the side
01:32:41 20 of the borehole. So in the reservoir, the sidewall core is
01:32:46 21 actually oriented in a horizontal direction.

01:32:48 22 When one takes that back into the laboratory and
01:32:50 23 measures the compressibility, you're essentially measuring the
01:32:54 24 compressibility of the reservoir rock in the horizontal
01:32:57 25 direction.

01:32:57 1 Of course, the compressibility that we are, in fact,
01:33:00 2 interested in is the compressibility of the rock in the
01:33:04 3 vertical direction. So this raises the question as to whether
01:33:06 4 or not these two values are the same or slightly different or
01:33:12 5 grossly different.

01:33:12 6 Q. You're aware that some experts have suggested that there
01:33:16 7 could be different UPVC values in the vertical direction versus
01:33:21 8 the horizontal direction?

01:33:25 9 A. Well, I'm aware that some people have asserted that, in
01:33:28 10 principle, it's a case that that could be the case, yes.

01:33:30 11 Q. As part of your analysis in this case, did you evaluate
01:33:33 12 whether or not anisotropy existed in the core samples that were
01:33:41 13 taken from the Macondo Reservoir?

01:33:42 14 A. Well, I did think about that, and there is some data and
01:33:45 15 some analysis that one can do to partially -- to address this
01:33:49 16 question.

01:33:49 17 Q. Before getting to your analysis, does the fact that a rock
01:33:54 18 is anisotropic with respect to one property mean that it will
01:34:00 19 be anisotropic with respect to another rock property?

01:34:03 20 A. Well, if I can back up a second. First, I would like to
01:34:09 21 point out that when one talks about anisotropy, it's important
01:34:13 22 to know that it's certainly a matter of degree. In other
01:34:17 23 words, if one could measure any rock property to five decimal
01:34:21 24 places, you might not find any piece of rock that's ideally
01:34:29 25 isotropic. So there is a question of how much anisotropy

01:34:29 1 exists.

01:34:31 2 Different properties can be anisotropic, so one could
01:34:36 3 have anisotropy with regards to compressibility. One could
01:34:37 4 have anisotropy with regards to permeability, electrical
01:34:41 5 resistivity, etcetera.

01:34:42 6 In general, there is no clear, direct correlation
01:34:46 7 between these; so, whereas, again, anisotropy in one property
01:34:54 8 might cause you to think that there might be anisotropy in
01:34:59 9 another and cause you to be sort of on the lookout for it, so
01:35:01 10 to speak, but there certainly isn't any direct correlations
01:35:03 11 that I'm aware of that says that if the rock is very
01:35:06 12 anisotropic with respect to permeability, it also anisotropic
01:35:14 13 by an equivalent percentage with regard to compressibility, so
01:35:16 14 it's not that simple.

01:35:17 15 Q. Let's look at D-23701, which is a demonstrative that we
01:35:22 16 looked at before lunch when we were talking about your analysis
01:35:28 17 of the hydrostatic stair-step test.

01:35:30 18 What do these results tell us about whether
01:35:33 19 pore volume compressibility is higher in the vertical direction
01:35:37 20 versus the horizontal direction?

01:35:39 21 A. Well, this hydrostatic test that I mentioned earlier is
01:35:43 22 conducted under the conditions where the stresses in all
01:35:47 23 directions are equal. That's what we mean by hydrostatic.

01:35:50 24 So in a sense the compressibility that one is
01:35:53 25 measuring during this hydrostatic test is an average

01:35:57 1 compressibility of all three directions, the issue of
01:36:00 2 compressing the rock equally in all three directions.

01:36:03 3 If it were the case, for example, that the rock were
01:36:06 4 twice as compressible in the vertical direction as in the
01:36:09 5 horizontal direction --

01:36:12 6 Q. So 12 versus 6?

01:36:13 7 A. -- so in that case, if, for example -- remembering that
01:36:16 8 there are two horizontal directions, sort of east/west and
01:36:20 9 north/south, so if it were the case that compressibility were
01:36:23 10 six in the east/west direction, six in the north/south
01:36:26 11 direction, but 12 in the vertical direction, the average of
01:36:29 12 those three values would be the average of six plus six plus 12
01:36:33 13 divided by three, which is eight.

01:36:35 14 So if it were the case that vertical compressibility
01:36:38 15 were equal to 12, I would expect the compressibility that one
01:36:42 16 extracts from the hydrostatic test to have been about eight,
01:36:48 17 i.e., higher than from the uniaxial test which measured the
01:36:53 18 horizontal compressibility.

01:36:54 19 As we see here, the value extracted from the
01:36:57 20 hydrostatic test was roughly about five. Actually, a little
01:37:00 21 bit less. I, again, sort of interpret that as probably lying
01:37:06 22 just within the natural variation that one core has a slightly
01:37:11 23 different compressibility than the other, but certainly this
01:37:13 24 evidence from this test argues strongly against the idea that
01:37:18 25 vertical compressibility was equal to 12, because, again, just

01:37:22 1 to recapitulate and summarize my point, if the vertical
01:37:26 2 compressibility were a 12, one would expect those yellow
01:37:29 3 numbers on the right, in the third and fourth column, to be
01:37:32 4 about eight, and they aren't.

01:37:34 5 Q. Based on the information that you reviewed, do you believe
01:37:37 6 there is any reason to increase the estimate of UPVC because of
01:37:42 7 anisotropy?

01:37:46 8 A. Well, no. This is the main piece of evidence that I can
01:37:50 9 rely on, as I'm trying to rely on measured data as much as
01:37:55 10 possible or exclusively in drawing my opinions. Certainly,
01:38:00 11 this piece of data does not argue at all for a vertical
01:38:03 12 compressibility that is even slightly larger than six, or
01:38:07 13 certainly it argues strongly against a vertical compressibility
01:38:13 14 equal to 12.

01:38:14 15 Q. Let's turn to a different topic. As part of your work in
01:38:18 16 this case, did you become aware of documents showing that for a
01:38:23 17 period of time in July 2010, BP employees were discussing and
01:38:29 18 using a UPVC value of 12 in some of their modeling?

01:38:34 19 A. Yes, I have read those -- that e-mail trail.

01:38:37 20 Q. Did you review those documents while you were forming your
01:38:43 21 opinions in this case?

01:38:44 22 A. Yes, I had read those documents during the period when I
01:38:48 23 was preparing my report, yes.

01:38:48 24 Q. Did those documents affect your opinion as to what is a
01:38:53 25 reliable estimate of the reservoir's UPVC?

01:38:58 1 A. No, it did not. If I can elaborate on that, there is
01:39:03 2 really nothing in those documents that indicated any scientific
01:39:08 3 arguments or data to justify a value of 12 microsips.

01:39:13 4 In fact, I think a close reading of those documents
01:39:16 5 shows that repeatedly -- I believe this point was mainly made
01:39:21 6 by Steve Willson, and sometimes by others -- that the data
01:39:25 7 clearly and very -- clearly leads to a value of about six.

01:39:30 8 So there was nothing in that discussion in terms of
01:39:33 9 data or scientific arguments that would change my opinion. I
01:39:39 10 guess I would characterize those discussions as sort of
01:39:43 11 speculative and speculating that there might be a large
01:39:49 12 anisotropic effect, but there's been certainly no data put
01:39:51 13 forward or reason to believe that that was the case.

01:39:54 14 Q. In your opinion, does the data support 12 microsips as the
01:40:01 15 compressibility of the Macondo Reservoir?

01:40:04 16 A. No, none of the data that I've seen. As I said, my
01:40:07 17 conclusion from the data is a value somewhat larger than six.
01:40:12 18 All of the other supporting data that I can look at that is
01:40:16 19 relevant to this issue, none of it points in the direction of a
01:40:24 20 value anywhere near 12 microsips.

01:40:26 21 Q. My final question is, is there any scientific basis in
01:40:30 22 your view to conclude that the UPVC of the Macondo Reservoir
01:40:34 23 was or is 12 microsips?

01:40:39 24 A. No, there is no data that I've seen that would lead me to
01:40:45 25 that conclusion or that I think would support that conclusion,

01:40:46 1 so no.

01:40:50 2 MR. FIELDS: Thank you.

01:40:52 3 Thank you, Your Honor.

01:40:53 4 THE COURT: All right. Thank you.

01:40:53 5 Cross.

01:41:50 6 MR. GLADSTEIN: Good afternoon, Your Honor. My name is
01:41:51 7 Richard Gladstein for the United States.

01:41:51 8 CROSS-EXAMINATION BY MR. GLADSTEIN:

01:41:54 9 Q. Good afternoon, Dr. Zimmerman. Good to see you.

01:41:57 10 A. Good afternoon.

01:42:01 11 Q. Dr. Zimmerman, I'm first going to ask you some questions
01:42:03 12 about your background.

01:42:06 13 You're not a petroleum engineer, correct?

01:42:13 14 A. Well, I'm a member of the Society of Petroleum Engineers,
01:42:15 15 but I'm a rock mechanics person by self-definition, yes.

01:42:19 16 Q. You're not a petroleum engineer, correct?

01:42:21 17 A. I don't work as a petroleum engineer, that's correct.

01:42:24 18 Q. You're not a petroleum engineer, are you? You don't work
01:42:29 19 as one, and you're not one, are you?

01:42:30 20 A. No, I'm a rock mechanics expert, yes.

01:42:33 21 Q. You're not a petroleum engineer, are you? Please just
01:42:36 22 answer my question.

01:42:36 23 A. Well, I was also the governors' lecturer of rock mechanics
01:42:40 24 and petroleum engineering at Imperial College for several
01:42:43 25 years, but I do not work as a petroleum engineer, and I have

01:42:46 1 not put myself forward as an expert in reservoir engineering.

01:42:49 2 Q. You are not a petroleum engineer, are you?

01:42:52 3 MR. FIELDS: Objection, asked and answered, Your Honor.

01:42:54 4 MR. GLADSTEIN: Let's go to his deposition, please.

01:42:57 5 THE COURT: I really think he's answered that.

01:43:01 6 MR. GLADSTEIN: Thank you, Your Honor.

01:43:01 7 EXAMINATION BY MR. GLADSTEIN:

01:43:01 8 Q. You are not an engineer of any kind, are you?

01:43:03 9 A. Well, I have three degrees in mechanical engineering, so
01:43:06 10 I'm not sure exactly what you're getting at, sir.

01:43:07 11 Q. You're not licensed as an engineer, are you?

01:43:09 12 A. No, I'm not licensed as an engineer, no.

01:43:11 13 Q. You have never been employed by an oil company, correct?

01:43:14 14 A. That's correct.

01:43:14 15 Q. You have never been involved in planning deepwater wells
01:43:19 16 in the oil and gas industry, correct?

01:43:21 17 A. That's correct.

01:43:21 18 Q. You've never been involved in drilling wells in deepwater,
01:43:21 19 correct?

01:43:26 20 A. That's correct.

01:43:26 21 Q. You've never been involved in drilling wells anywhere in
01:43:30 22 the oil and gas industry, correct?

01:43:32 23 A. No, I'm not a drilling engineer, that's correct.

01:43:34 24 Q. You have no experience working in the Gulf of Mexico
01:43:39 25 deepwater other than in this case, correct?

01:43:44 1 A. I believe that's true. This is the first time I've looked
01:43:47 2 in detail at rock compressibility data from the Gulf of Mexico,
01:43:51 3 yes.

01:43:51 4 Q. Thank you.

01:43:54 5 You're not a geologist, correct?

01:43:57 6 A. That is correct.

01:43:59 7 Q. You are not familiar with the geology of the Mississippi
01:44:05 8 Canyon area of the Gulf of Mexico, correct?

01:44:07 9 A. Well, I would like to point out that I don't believe that
01:44:10 10 such familiarity would have been necessary for me to analyze
01:44:13 11 the data from Weatherford; but, having said that, no, I'm not a
01:44:18 12 geologist.

01:44:18 13 Q. You're not familiar with the geology of the
01:44:20 14 Mississippi Canyon area of the Gulf of Mexico, right?

01:44:25 15 A. I would agree with that, yes.

01:44:26 16 Q. Thank you.

01:44:27 17 You have never personally performed stress,
01:44:30 18 deformation or other rock mechanics measurements on tests or
01:44:35 19 cores from the Gulf of Mexico other than in this case?

01:44:42 20 Let me withdraw that question. That was wrong.

01:44:43 21 You've never performed any rock mechanics tests on
01:44:49 22 cores from the Gulf of Mexico, correct?

01:44:51 23 A. I believe that's true, yes.

01:44:52 24 Q. You have no experience with uniaxial pore volume
01:44:58 25 compressibility -- and for purposes of ease, we'll just call

01:45:01 1 that UPVC -- testing of samples from the Gulf of Mexico
01:45:07 2 deepwater other than in the case, right?

01:45:10 3 A. I would like to say that the methods that one would use in
01:45:13 4 doing these experiments and the methods that I would use in
01:45:17 5 analyzing this data would be the same regardless of where the
01:45:20 6 rocks came from.

01:45:21 7 I've certainly looked at data in the course of my
01:45:25 8 career from various different places, and the methods that I've
01:45:29 9 used and theoretical understanding that I've brought to bear in
01:45:32 10 order to do that analysis has been essentially the same.

01:45:34 11 Q. Let's look at the answer that you gave at your deposition.

01:45:37 12 Could we please bring up the deposition 20 --
01:45:42 13 Page 20, lines 14 through 18. I'll read the question I asked
01:45:45 14 you and the answer that you gave -- excuse me, that would be
01:45:52 15 21, lines 1 to 6.

01:45:59 16 "Do you have any experience with pore pressure
01:46:06 17 depletion UPVC measurement of samples from the Gulf of Mexico
01:46:11 18 deepwater other than in this case," is my question. And your
01:46:12 19 answer was, "Specifically with regard to Gulf of Mexico rocks,
01:46:14 20 no."

01:46:15 21 That answer was correct at the time you gave it,
01:46:18 22 correct?

01:46:20 23 A. Yes, I believe it's still correct. I thought that's what
01:46:23 24 I just answered to your question. I'm sorry if I wasn't clear
01:46:26 25 enough.

01:46:27 1 Q. I apologize if I didn't hear it correctly.

01:46:30 2 You have never personally performed any UPVC tests
01:46:33 3 other than as part of your Ph.D. work in 1984; isn't that
01:46:33 4 right?

01:46:41 5 A. In terms of personally performing such work, as opposed to
01:46:45 6 supervising students who performed such work, that is correct.
01:46:49 7 My Ph.D. thesis involved a very large experimental component of
01:46:57 8 measuring pore volume compressibility of several rocks in a
01:46:57 9 range of pressures. Since then, I have not directly done these
01:47:01 10 experiments myself in the laboratory.

01:47:03 11 Q. Thank you.

01:47:04 12 That testing involved onshore consolidated sandstones
01:47:09 13 for your Ph.D., didn't it?

01:47:11 14 A. That's correct.

01:47:13 15 Q. Other than the work you performed in about 1984 related to
01:47:18 16 your Ph.D. thesis, you supervised one of your students who
01:47:21 17 performed UPVC tests several years ago; isn't that right?

01:47:26 18 A. Yes, one of my Ph.D. students has done pore volume
01:47:31 19 compressibility measurements under my supervision, that's
01:47:33 20 correct.

01:47:33 21 Q. That student had to go to Paris to conduct testing because
01:47:36 22 you have no rock mechanics laboratory at the Imperial College;
01:47:41 23 isn't that right?

01:47:42 24 A. No, no, that's not correct. I'm sorry if you drew an
01:47:46 25 incorrect inference from my responses.

01:47:48 1 Those experiments were done at Imperial College. I
01:47:53 2 did refer to a more recent student who has been doing
01:47:57 3 measurements of acoustic wave velocities, and that is the
01:48:02 4 student who did the experiments in Paris two years ago.

01:48:06 5 The other Ph.D. student, Ms. Al-Wardy, I believe it
01:48:09 6 was about 2003, she finished her Ph.D. at Imperial College, and
01:48:15 7 those experiments were done under my supervision at
01:48:17 8 Imperial College, London.

01:48:19 9 Q. Let's see what you said in your deposition.

01:48:21 10 Please bring up Page 377, lines 6 through 9. 377,
01:48:39 11 6 through 9, please.

01:48:47 12 The question, "And you don't have experimental
01:48:50 13 apparatus in your own laboratory for conducting acoustic tests,
01:48:54 14 do you?" And your answer is, "Not at this time."

01:48:57 15 So that's what you were just clarifying; is that
01:48:59 16 right, Dr. Zimmerman?

01:48:59 17 A. Yes, that answer was the acoustic measurements that are
01:49:02 18 being made -- or were made in the last year or so in Paris by
01:49:05 19 one of my Ph.D. students, yes.

01:49:07 20 Q. Do you have facilities in your laboratory at this time for
01:49:11 21 conducting UPVC tests?

01:49:14 22 A. No, I think I made -- tried to make clear at the
01:49:19 23 deposition, I'm not currently supervising laboratory work at
01:49:25 24 Imperial College.

01:49:26 25 In the occasions when my students need to do

01:49:29 1 laboratory work, they go overseas, such as the one in Paris,
01:49:32 2 another one at TerraTek in Salt Lake City, etcetera.

01:49:37 3 Q. Thank you, Doctor.

01:49:40 4 You are not a petrophysicist, correct?

01:49:43 5 A. Well, again, not by job title. I have taught a course at
01:49:47 6 Imperial College called Rock Physics, which is basically
01:49:50 7 another name for petrophysics, but I'm not a petrophysicist by
01:49:56 8 job title, that's correct -- yes.

01:49:57 9 Q. You're not a rock physicist, are you?

01:50:01 10 A. Actually, I would call myself a rock physicist. Those
01:50:04 11 terms might sound very similar. If one looks at a very famous
01:50:10 12 book called *Handbook of Rock Physics* written by a very renowned
01:50:16 13 group of scientists from Stanford, one will find my name in
01:50:21 14 that book mentioned 17 times, so I think that's some evidence
01:50:23 15 that I do operate in the realm of rock physics.

01:50:27 16 Q. Well, let's turn to your deposition, page 33, lines 14
01:50:30 17 through 24, please.

01:50:35 18 I asked you the question, "Do you have expertise in
01:50:39 19 petrophysics? Are you an expert in petrophysics?" Your answer
01:50:43 20 was, "I've done some research that I think would fall under the
01:50:48 21 category of petrophysics. I don't define myself as a
01:50:52 22 petrophysicist."

01:50:54 23 Continuing your answer, "In some sense, one can think
01:50:57 24 of petrophysics as being a subset of the broader field of rock
01:51:02 25 mechanics. Petrophysics, by definition, meaning the physical

01:51:06 1 behavior of rocks. Petro, I believe, is the Greek word for
01:51:10 2 rocks."

01:51:11 3 MR. FIELDS: Your Honor, that's not impeachment.

01:51:11 4 THE COURT: Pardon?

01:51:15 5 MR. FIELDS: I'm sorry, Your Honor. That's not
01:51:16 6 impeachment. That's not a proper impeachment.

01:51:21 7 THE COURT: I think I agree with that. I sustain that
01:51:23 8 objection.

01:51:23 9 EXAMINATION BY MR. GLADSTEIN:

01:51:27 10 Q. Moving on, sir, you've never estimated compressibility
01:51:31 11 other than in this case where there has been a well blowout; is
01:51:34 12 that right?

01:51:34 13 A. That is correct.

01:51:34 14 Q. I'm now going to ask you several questions about the
01:51:37 15 information you relied on in the preparation of your report.

01:51:39 16 For the preparation of your report, the only
01:51:43 17 Macondo-specific data you relied on was from the rotary
01:51:46 18 sidewall cores tested by Weatherford, correct?

01:51:50 19 A. Yes, as I mentioned previously, that was the only
01:51:52 20 laboratory data that was available because I believe there were
01:51:55 21 no other types of core data available.

01:51:58 22 Q. You did not look at any drilling data from the
01:52:01 23 Macondo Well, did you?

01:52:03 24 A. That is correct.

01:52:04 25 Q. You did not look at any of the well log data from Macondo

01:52:08 1 in the preparation of your report, did you?

01:52:14 2 A. No, I relied on the laboratory measurements that were most
01:52:18 3 pertinent to the property of uniaxial pore volume
01:52:27 4 compressibility, that's correct.

01:52:27 5 Q. I'm now going to ask you some questions about the
01:52:27 6 Weatherford cores.

01:52:28 7 First, on the subject of representativeness, the
01:52:30 8 three UPVC samples analyzed by Weatherford constituted well
01:52:35 9 less than one percent of the thickness of the reservoir as a
01:52:39 10 whole; isn't that right?

01:52:41 11 A. Yes, that is correct.

01:52:41 12 Q. In fact, the eight samples, when you include the UPVC, the
01:52:46 13 hydrostatic and the ultrasonic combined that you looked at,
01:52:51 14 also constituted less than one percent of the reservoir,
01:52:53 15 correct?

01:52:53 16 A. Yes. Yes. That's correct. Those were the only data that
01:53:01 17 were available, yes.

01:53:01 18 Q. You calculated your UPVC values from the raw pressure and
01:53:10 19 the strain data reported by Weatherford, didn't you?

01:53:10 20 A. Yes.

01:53:10 21 Q. Weatherford did not actually calculate or report any UPVC
01:53:14 22 values, correct?

01:53:19 23 A. Actually, I believe they did report them. I didn't use
01:53:21 24 their calculated values. I took their raw data and did my own
01:53:25 25 calculation, which I not only believe is more accurate, but

01:53:31 1 actually led to a slightly higher value than Weatherford had
01:53:35 2 calculated.

01:53:35 3 Q. Are you testifying that they came up with particular UPVC
01:53:39 4 values for those three cores?

01:53:48 5 A. I seem to remember that they came up with tables of values
01:53:51 6 as a function of pressure, but in any event, I didn't rely on
01:53:54 7 their calculation.

01:53:56 8 Q. But they didn't measure each core at a particular microsip
01:54:01 9 level, correct? That was your calculation that led you to the
01:54:05 10 conclusion as to what the appropriate microsip level was,
01:54:07 11 correct?

01:54:07 12 A. Yeah, it was my calculation that led me to that value,
01:54:13 13 yes.

01:54:17 14 Q. Now, of the 44 rotary sidewall cores that you looked at
01:54:21 15 for your UPVC tests, the three cores were approximately 1 inch
01:54:25 16 in length and 1 inch in diameter; isn't that right?

01:54:31 17 A. Approximately that is correct.

01:54:32 18 Q. And the reservoir is approximately 90 feet thick; isn't
01:54:32 19 that right?

01:54:38 20 A. Yes. As is almost always the case in petroleum reservoir
01:54:43 21 evaluation, the amount of core represents a small fraction of
01:54:48 22 the total reservoir.

01:54:49 23 Q. Now, are you aware that the reservoir was approximately
01:54:56 24 5,000 acres in area?

01:54:57 25 A. Yes.

01:54:59 1 Q. Now, are you aware that BP obtained wireline log data for
01:55:07 2 the Macondo Well?

01:55:07 3 A. Yes.

01:55:10 4 Q. The log data provides information for the entire thickness
01:55:15 5 of the reservoir at the well location, doesn't it?

01:55:19 6 A. Yes, I believe it does.

01:55:20 7 Q. But you did not consider the log data in the preparation
01:55:24 8 of your report, did you?

01:55:26 9 A. No. I thought the most accurate values could be obtained
01:55:29 10 from the direct measurements on the cores.

01:55:31 11 Q. You're not someone who looks at logs as part of your work,
01:55:35 12 either on a routine basis or an occasional basis, are you?

01:55:39 13 A. That is correct.

01:55:39 14 Q. And you're by no means an expert in logs, are you?

01:55:43 15 A. I will agree with that, yes.

01:55:44 16 Q. I'm going to ask you now some questions about the
01:55:47 17 differences between conventional or whole cores and rotary
01:55:51 18 sidewall cores.

01:55:52 19 Dr. Zimmerman, is it your position that rotary
01:55:56 20 sidewall cores are just as reliable as conventional cores for
01:56:02 21 purposes of UPVC testing?

01:56:03 22 A. Well, as I've mentioned previously, I think the only real
01:56:06 23 issue that needs to be discussed in this context is the issue
01:56:09 24 of anisotropy, so there is an issue of anisotropy that arises
01:56:16 25 when trying to convert values measured on rotary sidewall cores

01:56:18 1 to the value that you would have measured on a conventional
01:56:21 2 core.

01:56:21 3 Other than that, if you're talking about anything
01:56:24 4 intrinsic about the core itself, that would -- that would
01:56:30 5 invalidate the actual measurement made on that core, I don't
01:56:33 6 think there is, but as I mentioned previously, using rotary
01:56:37 7 sidewall core does raise the issue of anisotropy that needs to
01:56:43 8 be addressed.

01:56:43 9 Q. And you're aware that in deciding what type of cores to
01:56:46 10 take of the Macondo Well, BP stated that rock compressibility
01:56:50 11 measurements from whole cores were more reliable than
01:56:54 12 compressibility rock measurements from sidewall cores; isn't
01:56:57 13 that right?

01:57:01 14 A. I believe I've seen something to that effect in some of
01:57:04 15 the BP documents, yes, I think so.

01:57:05 16 Q. Let's bring up TREX-11503.1.1.US.

01:57:17 17 This is an e-mail from Tanner Gansert dated
01:57:22 18 October 22, 2009, with the attachment "Macondo Core VOI," value
01:57:29 19 of information.

01:57:31 20 Let's go to TREX-11503.25.1.US.

01:57:39 21 Do you recall at your deposition that I asked you
01:57:42 22 about this document? Do you recall the page that said,
01:57:47 23 "Pro core bias compressibility measurements from rotary
01:57:52 24 sidewall core are too uncertain to add value"? Do you recall
01:57:55 25 that I showed you this at your deposition?

01:57:59 1 A. I'm not sure I recall that. I do remember reading these
01:58:03 2 documents as part of the BP paper trail. I remember reading
01:58:06 3 these documents, yes.

01:58:07 4 Q. And at the same time, BP said that whole core
01:58:11 5 compressibility measurements are 100 percent accurate.

01:58:15 6 You agree that whole core compressibility
01:58:17 7 measurements provide very accurate information, don't you?

01:58:20 8 A. Yes, of course. Of course, they can provide accurate
01:58:28 9 information, if one has such data available, of course.

01:58:32 10 Q. And in making that decision, you recall that BP noted that
01:58:36 11 whole cores would cost \$7 million, do you remember that, when
01:58:41 12 reviewing this information?

01:58:43 13 A. I do remember seeing that point made, yes. The costs
01:58:47 14 being cited, yes.

01:58:48 15 Q. And you're also aware that rotary sidewall cores can be
01:58:53 16 easily and inexpensively collected; isn't that right?

01:58:58 17 A. I'm not sure I would say *inexpensively*. I would imagine
01:59:03 18 they are still quite costly to collect. I was not involved in
01:59:07 19 any decision about which type of cores to take. I can only
01:59:13 20 analyze, as an expert in core volume compressibility, the data
01:59:18 21 such as it exists.

01:59:19 22 Q. Are you aware that BP considered rock compressibility
01:59:24 23 results from whole core samples from the Santa Cruz Well in the
01:59:28 24 Gulf of Mexico in developing compressibility estimates for the
01:59:32 25 Macondo Well?

01:59:34 1 A. I do recall at various points they were looking at other
01:59:38 2 nearby wells for the purposes of gaining some understanding,
01:59:43 3 presumably, of what type of values they might expect to find.

01:59:46 4 Q. And do you recall that at the Santa Cruz Well data from
01:59:51 5 whole core produced higher rock compressibility results than
01:59:55 6 data from sidewall cores from the same well?

02:00:00 7 A. No. Actually, that -- I don't recall that. That wasn't
02:00:04 8 my interpretation of that -- of those discussions.

02:00:07 9 My best interpretation -- and I think it's always
02:00:13 10 difficult to interpret those sort of discussions because they
02:00:16 11 were taking place among people, all of whom shared certain
02:00:19 12 knowledge and certain background information, and I'm just sort
02:00:22 13 of reading from the outside. But my interpretation was
02:00:24 14 actually that they were comparing measurements on rotary
02:00:28 15 sidewall cores from one reservoir to measurements made on whole
02:00:33 16 core from another reservoir. That was my interpretation.

02:00:36 17 Q. Well, let's turn -- pull up the TREX and see what the
02:00:40 18 document says. Maybe we're thinking about the same document;
02:00:44 19 maybe we're not.

02:00:45 20 TREX-8772.1.4.US, please.

02:00:55 21 This is what I was referring to, Dr. Zimmerman. This
02:00:58 22 is an e-mail from David Schott sent Tuesday, July 6, 2010.

02:01:07 23 It says, "Hi, Kelly. If you think the Macondo rocks
02:01:10 24 are lower compressibility, you might use a similar upgrade
02:01:14 25 going from sidewall to whole core as what we found going from

02:01:20 1 the sidewall in SC and Isabela to whole core in SC."

02:01:30 2 SC there is referring to Santa Cruz.

02:01:36 3 A. And your question is, I'm sorry?

02:01:42 4 Q. Is that the discussion that you are thinking of,
02:01:46 5 Dr. Zimmerman?

02:01:46 6 A. That's one of the discussions that I remember seeing, yes.

02:01:49 7 Q. And this indicates that there was an upgrade found in
02:01:56 8 going from sidewall core in Santa Cruz to sidewall core -- to
02:02:03 9 whole core in Santa Cruz, doesn't it?

02:02:08 10 A. That's certainly one way one could interpret this, yes.

02:02:12 11 Q. Let's look at another document and see if we can get any
02:02:14 12 more insight on this.

02:02:17 13 Can we please bring up TREX-130863.1.US.

02:02:27 14 So this is another e-mail from David Schott, the
02:02:30 15 reservoir engineer, October 26, 2009. David Schott notes that
02:02:44 16 the new compressibility data from whole core at the nearby well
02:02:49 17 Santa Cruz increased BP's estimate of the oil recovery by
02:02:54 18 16 million barrels of oil. Doesn't he?

02:02:59 19 A. I'm sorry. I'm losing you here, I'm sorry. I expected
02:03:04 20 you to be reading the yellow underlines.

02:03:08 21 Q. I apologize. I'm getting ahead of myself here.

02:03:11 22 This is from Mr. Schott to Brad and he says in the
02:03:15 23 highlighted, "I recommend you plan on running the bypass unless
02:03:19 24 you encounter a clear set of conditions that would preclude
02:03:24 25 running whole core."

02:03:25 1 Do you know what a *bypass* is?

02:03:27 2 A. I'm not exactly sure what he's talking about in this
02:03:31 3 context, no.

02:03:32 4 Q. Okay. My understanding is that a bypass core is the same
02:03:36 5 as a whole core, but it's off to the side of the well rather
02:03:41 6 than in the borehole. Is that consistent with your
02:03:45 7 understanding?

02:03:45 8 A. I honestly am not sure I have ever heard of that term used
02:03:52 9 in this context before, so I don't know.

02:03:52 10 Q. Okay. It says, "Attached" -- in the second highlight,
02:03:56 11 "Attached is the decision tree we use with our partner Noble to
02:04:01 12 make the decision to run a bypass core in the Santa Cruz Well."

02:04:07 13 Further highlight. "As mentioned in our meeting, we
02:04:10 14 were basing our development decisions on 27 percent RF" --

02:04:15 15 Do you know what *RF* stands for?

02:04:19 16 A. I guess recovery factor, my guess would be, in this
02:04:22 17 context.

02:04:23 18 Q. -- "27 percent recovery factor from rotary sidewall core.
02:04:29 19 With the new compressibility derived from whole core, this will
02:04:34 20 push RF to 35 percent," continuing to the end of the sentence
02:04:40 21 there, "16 mmbobe increase."

02:04:46 22 That's what it says, doesn't it, Dr. Zimmerman?

02:04:50 23 A. Well, I think you just read the statement.

02:04:53 24 Q. Yeah. So in other words --

02:04:54 25 A. I'm not sure what conclusion you're trying to draw.

02:04:57 1 Q. So in other words, David Schott, the BP
02:04:59 2 Reservoir Engineer, is saying based upon taking whole core at
02:05:05 3 Santa Cruz, in addition to the sidewall core, they increase
02:05:09 4 their expectation for obtaining more oil out of that well
02:05:13 5 significantly. The difference between 27 percent recovery
02:05:18 6 factor and a 35 percent recovery factor; isn't that right?

02:05:22 7 MR. FIELDS: Objection, Your Honor. Lack of
02:05:24 8 foundation.

02:05:26 9 THE COURT: Overrule the objection.

02:05:26 10 EXAMINATION BY MR. GLADSTEIN:

02:05:31 11 Q. Dr. Zimmerman --

02:05:32 12 THE COURT: Wait. Did he ever respond to that
02:05:34 13 question? I overruled the objection. Do you want an answer or
02:05:39 14 not?

02:05:40 15 MR. GLADSTEIN: I would like him to, Your Honor.

02:05:45 16 THE WITNESS: Again, I'm sorry --

02:05:46 17 THE COURT: Do you remember the question?

02:05:49 18 THE WITNESS: No, Your Honor. I'm sorry. Even before
02:05:50 19 the objection, I was having trouble following the line of
02:05:54 20 questioning, I'm sorry.

02:05:54 21 THE COURT: Restate your question.

02:05:56 22 EXAMINATION BY MR. GLADSTEIN:

02:05:59 23 Q. Dr. Zimmerman, based upon this e-mail, it looks like
02:06:02 24 the -- BP expected that the amount of oil that they were going
02:06:07 25 to be able to get out of the Santa Cruz Well was going to

02:06:10 1 increase from a recovery factor of 27 percent based on the
02:06:15 2 sidewall core data to a recovery factor of 35 percent based
02:06:19 3 upon the whole core data; isn't that right?

02:06:22 4 A. Well, that's what it says, yes. It's not -- again, I can
02:06:32 5 try to interpret this. It's not fully clear to me whether the
02:06:35 6 increase in STOIIP comes from different compressibilities or it
02:06:41 7 comes from different recovery factor, because you might have
02:06:44 8 recovery factor appearing in their calculation of how certain
02:06:46 9 they are about the oil in place.

02:06:48 10 So based on this, quite honestly, I can't tell which
02:06:52 11 one of those two factors led them to increase the STOIIP.

02:06:57 12 But certainly on the face of it, I still don't really
02:07:00 13 see a clear statement here that the compressibility is measured
02:07:06 14 on the so-called whole core were twice as high as those
02:07:09 15 measured on the rotary sidewall core. I honestly don't
02:07:13 16 actually see that stated here clearly.

02:07:15 17 Q. Dr. Zimmerman, I'm now going to move on to ask you a
02:07:24 18 series of questions about the orientation of sidewall cores.

02:07:28 19 Now, it's preferable to have the orientation of the
02:07:31 20 core in the lab match the orientation of compaction in the
02:07:37 21 reservoir, isn't it?

02:07:38 22 A. Yeah, I think there is no doubt, I thought I mentioned
02:07:41 23 that earlier, that all other things being equal, if one had a
02:07:45 24 core that were oriented in the vertical direction, it would be
02:07:50 25 preferable because it would remove this issue of anisotropy.

02:07:50 1 So yes, it certainly would be preferable if it were, if it were
02:08:00 2 possible to be the case, yes.

02:08:00 3 Q. And the testing conditions in the laboratory did not
02:08:03 4 match, I believe you've testified, the in situ conditions in
02:08:08 5 the actual reservoir with respect to the orientation or
02:08:10 6 direction of the cores, correct?

02:08:12 7 A. Yes. As I've said, measurements made in the laboratory
02:08:16 8 were essentially measuring horizontal compressibility, not
02:08:21 9 vertical compressibility, and that's what initiated the
02:08:25 10 previous discussion about possible anisotropy.

02:08:29 11 Q. Are you aware that BP had concerns with respect to the
02:08:33 12 Isabela Well about the orientation of sidewall cores in terms
02:08:36 13 of their ability to accurately predict compressibility?

02:08:45 14 A. I think, yeah, this was one of the themes that seemed to
02:08:48 15 run through the e-mail trail that I read, was this issue of
02:08:51 16 whether or not -- they were unsure that measurements made on
02:08:55 17 horizontal oriented sidewall cores would accurately reflect the
02:09:01 18 vertical compressibility. That was a concern that they had,
02:09:03 19 yes.

02:09:03 20 Q. And that was a concern that they expressed in this
02:09:06 21 July 6th and July 8th period when they came up with the most --
02:09:11 22 new most likely recommendation of 12 microsips; isn't that
02:09:11 23 right?

02:09:18 24 A. Yeah. It's right in the sense that it was the same period
02:09:22 25 of time that both of those -- that those concerns were

02:09:25 1 mentioned and this value of 12 was hypothesized.

02:09:30 2 As I mentioned before, I still have not seen any data
02:09:34 3 to support that, but it is true that some people were
02:09:38 4 suggesting a value of 12 for various reasons.

02:09:41 5 Q. And, in fact, in this period between July 6th and
02:09:46 6 July 8th, when the new recommendation was made, BP considered
02:09:51 7 UPVC data from the Isabela Well as part of the data that they
02:09:57 8 considered in making this new recommendation, didn't they?

02:09:58 9 A. Well, they did seem to be looking at data from different
02:10:04 10 wells, yes. That seemed to be part of their discussion, yes.

02:10:06 11 Q. Okay. Let's turn to TREX-800 -- I'm sorry, 8770.1.2.US,
02:10:20 12 please.

02:10:23 13 And this is one of those e-mails. And I know,
02:10:25 14 Your Honor, you're probably tired of them already, and I'm
02:10:28 15 going to try not to belabor this.

02:10:29 16 So this is an e-mail from Jessica Kurtz sent July 6,
02:10:37 17 2010, to Kelly McAughan, David Schott, cc: Robert Merrill,
02:10:43 18 "Subject: Compressibility." "Attachments: Isabela Comp
02:10:48 19 Table, Isabela Rock Mechanics Report."

02:10:50 20 So they were considering the data from the
02:10:53 21 Isabela Well at the time that they decided to make a new
02:10:58 22 recommendation, isn't that right, Dr. Zimmerman?

02:11:02 23 A. Well, actually, I think this may well be the document that
02:11:04 24 I was remembering that seemed to imply to me that they were
02:11:08 25 comparing sidewall cores at Isabela to whole core at

02:11:14 1 Santa Cruz. So if I can return to that point, this is what was
02:11:16 2 in my mind, I think, when I answered -- gave the answer to your
02:11:21 3 question a few minutes ago.

02:11:23 4 Q. Okay. It says -- the next highlight says, "Also, included
02:11:29 5 is the Isabela sidewall core data." And the next highlight,
02:11:35 6 "We have since updated this table to the ones I sent previously
02:11:39 7 based on the Santa Cruz, SC, whole core."

02:11:49 8 Now, could we please go to TREX-11505.1.1.US.

02:12:04 9 Again, this is one of the documents that we reviewed
02:12:06 10 at your deposition, title, "Isabela Core Volume Compressibility
02:12:19 11 Evaluation," reviewed by Stephen Willson, along with
02:12:20 12 David Schott, BP personnel, October 11, 2007.

02:12:22 13 If we could turn to 11505.3.1.US, Figure 1, please.

02:12:32 14 Dr. Zimmerman, this figure concerns the different
02:12:37 15 impact of testing rotary sidewall cores versus whole cores,
02:12:46 16 doesn't it?

02:12:47 17 A. Yes, I believe it does.

02:12:48 18 Q. So on the left, in the field, compaction occurs
02:12:56 19 perpendicular to the bedding planes. That's what you've
02:12:59 20 indicated; isn't that right?

02:13:00 21 A. Yes, that's correct.

02:13:00 22 Q. And according to this drawing, you'll see the layers of
02:13:05 23 rock are horizontal, but the compaction, because the pressure
02:13:11 24 is applied vertically, the compressibility is going to be more,
02:13:18 25 isn't that right, Dr. Zimmerman?

02:13:21 1 A. Well, maybe; maybe not. This just is another way of
02:13:24 2 addressing the question of anisotropy that we discussed
02:13:29 3 earlier. In some cases the rock would be more compressible in
02:13:34 4 the vertical direction. There actually are cases where rocks
02:13:36 5 are less compressible in the vertical direction. It's
02:13:39 6 certainly more common that they are more compressible in
02:13:42 7 vertical direction.

02:13:43 8 There are also many rocks where the compressibility
02:13:46 9 in the two directions are essentially the same to a very high
02:13:50 10 degree of accuracy.

02:13:51 11 I can also say that I'm not aware of any laboratory
02:13:55 12 data that I've seen in the refereed, peer-reviewed scientific
02:13:59 13 literature that shows anisotropy factor of two for a sandstone.
02:14:05 14 I just have not seen such data in the peer-reviewed scientific
02:14:08 15 literature.

02:14:09 16 Q. On the right corner of this figure, it says, "Lab
02:14:15 17 compaction occurs parallel to bedding planes."

02:14:18 18 So in other words, this is a horizontal core,
02:14:21 19 correct, taken off the side of the well, and it's turned on its
02:14:26 20 head so that your layers are up and down and that that's going
02:14:29 21 to be -- in the lab it's going to have a -- what they are
02:14:32 22 showing here is a stiffer result, less compression; isn't that
02:14:32 23 right?

02:14:41 24 A. Again, it depends on the specific rock. It also supposes
02:14:45 25 that there are clearly defined bedding planes and striations in

02:14:50 1 the rock, which in many cases in sandstones, when you look at
02:14:54 2 them -- and I'm not an expert in petrographic analysis of
02:14:57 3 sandstones, but I have looked at thin sections -- and in many
02:15:01 4 cases you can't see any apparent orientation of bedding plane.

02:15:04 5 So this is one possible scenario, but this is not the
02:15:08 6 general universal case.

02:15:12 7 THE COURT: Where does this document come from? What
02:15:15 8 is this document I'm looking at?

02:15:17 9 MR. GLADSTEIN: So this is a report that BP did on the
02:15:23 10 compressibility at a nearby well, Isabela, and they are
02:15:29 11 raising, in the document, certain concerns they have about the
02:15:33 12 reliability of the sidewall core values that were obtained.

02:15:39 13 THE COURT: But it's a BP document?

02:15:40 14 MR. GLADSTEIN: Yes, I'm sorry, Your Honor.

02:15:42 15 THE COURT: That's what I was trying to figure out.

02:15:43 16 MR. GLADSTEIN: I should have answered more succinctly.

02:15:47 17 MR. FIELDS: Your Honor, sorry, it seems to me this
02:15:49 18 whole line of questions is really irrelevant to the issues at
02:15:52 19 hand here.

02:15:53 20 THE COURT: Well, I'm not sure.

02:15:55 21 MR. GLADSTEIN: I don't think it's irrelevant. He said
02:15:57 22 that anisotropy is key.

02:16:01 23 THE COURT: Go ahead.

02:16:01 24 EXAMINATION BY MR. GLADSTEIN:

02:16:03 25 Q. So BP states, "PVC tests in the laboratory may

02:16:09 1 underpredict compaction since rotary sidewall core undergo
02:16:14 2 compaction in parallel to bedding planes in which rocks are
02:16:18 3 typically stiffer. In the field, compaction occurs
02:16:21 4 perpendicular to bedding in which rocks are typically softer."

02:16:26 5 You agree with that statement, don't you?

02:16:30 6 A. Yeah, as a qualitative statement, I think that's generally
02:16:34 7 true. As I mentioned, there are actually cases where rocks are
02:16:37 8 stiffer in the vertical direction, but more commonly, if there
02:16:40 9 is a difference in stiffness, the rock might be more -- might
02:16:44 10 be more compressible in the vertical direction. That's
02:16:47 11 certainly a possibility.

02:16:47 12 And I think that was, again, the starting point in
02:16:50 13 the whole discussion of anisotropy, and that is, in fact, what
02:16:55 14 caused me to do my analysis based on the stair-step porosity
02:17:01 15 tests to try to rule out the existence of a gross amount of
02:17:05 16 anisotropy.

02:17:14 17 Q. Since most sedimentary and metamorphic rocks are
02:17:22 18 anisotropic, the effect of anisotropy on strength is of great
02:17:30 19 importance; isn't that right?

02:17:31 20 A. Well, I believe that's a quote from my book, *Fundamentals*
02:17:35 21 *of Rock Mechanics*, so yes, but also I point out that it was a
02:17:38 22 discussion of strength, which is very different from
02:17:43 23 compressibility. We can -- I can elaborate on that if you
02:17:47 24 want. But certainly, no, anisotropy is an issue that needs to
02:17:51 25 be addressed, and I think I tried to address it the best I

02:17:54 1 could based on the actual data that we had at hand.

02:18:07 2 Q. How do you define laminations?

02:18:13 3 A. I'm not sure that I would define it because I think we've
02:18:16 4 already established I'm not a petrophysicist or a geologist,
02:18:20 5 but in layman's terms, I think of it as some sort of obvious
02:18:25 6 layering that one could determine by visual inspection of a
02:18:29 7 rock.

02:18:29 8 Q. To determine if laminations were present in a CT scan of a
02:18:33 9 core, you would look at different levels of darkness indicating
02:18:38 10 different properties of thin layers of the rock; isn't that
02:18:40 11 right?

02:18:41 12 A. That's what I would do, yes.

02:18:42 13 Q. Now, you've seen CT scans of the cores that were sampled
02:18:47 14 for the UPVC samples; isn't that right?

02:18:52 15 A. Yes, I have.

02:18:52 16 Q. And you saw laminations in at least one of those three
02:18:56 17 cores that were UPVC tested, didn't you?

02:19:00 18 A. I think -- I think you're referring to a discussion we had
02:19:05 19 at the deposition, and I think at the time I did say that it
02:19:08 20 might be possible to detect what seemed to my untrained eye as
02:19:12 21 being laminations in one of those cores, yes.

02:19:14 22 Q. Dr. Zimmerman, let's turn to the subject of sample
02:19:20 23 dimensions.

02:19:22 24 Rotary sidewall cores are normally 2 inches in
02:19:26 25 length; isn't that right?

02:19:32 1 A. Possibly. It sounds about right. It might vary from
02:19:37 2 vendor to vendor, but yes.

02:19:38 3 Q. The three rotary sidewall cores tested for UPVC were
02:19:42 4 approximately 1 inch in length; isn't that right?

02:19:45 5 A. That's why I was -- my little hesitation was, yes. The
02:19:49 6 cores that were used in these tests that we're referring to
02:19:51 7 here that were carried out by Weatherford were, I believe,
02:19:54 8 about 1.1 to 1.25 inches in length, yes.

02:19:59 9 Q. Let's turn to TREX-11501.1.1.US, please.

02:20:09 10 Do you recall that at your deposition I showed you
02:20:12 11 some documents from the Weatherford website, one regarding
02:20:17 12 rotary sidewall cores?

02:20:21 13 A. I think I've seen this document before. I can't remember
02:20:23 14 exactly where, but I believe I've seen it.

02:20:25 15 Q. And Weatherford says on its website, in the highlighted,
02:20:30 16 "This method uses a small robotic core bit of approximately
02:20:36 17 1 inch in diameter to drill sideways into the formation,
02:20:42 18 period. The 2-inch long core is then removed into the main
02:20:49 19 coring tool for retrieval."

02:20:52 20 Does that refresh your recollection as to the normal
02:20:54 21 length for rotary sidewall cores?

02:21:00 22 A. Okay. Well, that's what it seems to say here, yes.

02:21:04 23 Q. Now, you would agree the length -- the length-to-diameter
02:21:07 24 ratio is an important consideration in strength measurements;
02:21:07 25 isn't that right?

02:21:15 1 A. In strength measurements, which, again, I'll mention are
02:21:17 2 very different, really completely different measurements than
02:21:22 3 compressibility measurements.

02:21:24 4 In certain types of strength measurements one tries
02:21:27 5 to compress the rock to a point where the fault plane passes
02:21:30 6 through the rock. In general, that fault plane comes in at
02:21:33 7 something like a 45-degree angle. And it is generally thought
02:21:36 8 that you want -- you generally want the fault -- the core to be
02:21:43 9 sufficiently long such that this fault plane breaks through the
02:21:48 10 rock at the side rather than breaking through at the upper
02:21:51 11 plate.

02:21:53 12 So this issue of length-to-diameter ratio is an
02:21:57 13 important consideration when doing that particular type of
02:21:59 14 strength measurement. I don't think any of those
02:22:03 15 considerations are relevant to compressibility measurements
02:22:06 16 where by definition you're not compressing the rock until it
02:22:10 17 breaks, so --

02:22:13 18 Q. For triaxial rock mechanics tests a length-to-diameter
02:22:19 19 ratio of 2 to 1 or 3 to 1 is commonly used; isn't that right?

02:22:23 20 A. Yes, I would say that's true.

02:22:24 21 Q. Now, it's your position that the length-to-diameter ratio
02:22:31 22 of rotary sidewall cores does not impact the UPVC results; is
02:22:35 23 that correct?

02:22:35 24 A. Yes. I don't believe the length-to-diameter ratio has an
02:22:41 25 appreciable effect on pore volume compressibility measurements,

02:22:46 1 that is true.

02:22:46 2 Q. Are you aware that BP disagreed with that position in the
02:22:52 3 Isabela memo that we were just looking at?

02:22:55 4 A. I'm not sure that I remember that that's what they say,
02:23:01 5 but I prefer to answer in terms of what I believe and what I
02:23:06 6 understand based on my knowledge of rock mechanics.

02:23:09 7 Q. Could we please turn to TREX-11505.1.2.US.

02:23:21 8 Again, this is a document that we looked at, at your
02:23:24 9 deposition. The first sentence concerns the UPVC value that
02:23:28 10 was determined by the laboratory for Isabela, which was
02:23:35 11 14.6 for the upper sands and 13.7 for the lower sands.

02:23:38 12 Then there is a sentence that says, "Testing protocol
02:23:41 13 and sample size effects (specifically length-to-diameter ratio)
02:23:46 14 may result in this value underestimating the actual reservoir
02:23:49 15 compressibility."

02:23:54 16 Do you disagree with BP with respect to that
02:23:57 17 statement?

02:23:58 18 A. I'm not aware of any information, either experimental or
02:24:03 19 theoretical, that would lead me to make that conclusion. So
02:24:07 20 I'm not sure on what they've based this conclusion, but I guess
02:24:10 21 my simple answer is, no, I don't believe -- I don't think I do
02:24:13 22 agree with that.

02:24:14 23 Q. Okay. Dr. Zimmerman, thank you.

02:24:17 24 I'm now going to ask you some questions about the
02:24:20 25 Weatherford testing procedures.

02:24:22 1 On the subject of saturation with brine, the testing
02:24:28 2 conditions in the laboratory did not match the in situ
02:24:31 3 conditions in the actual reservoir with respect to saturation
02:24:34 4 of the cores; isn't that right?

02:24:37 5 A. Well, they are not necessarily intended to match the
02:24:41 6 in situ conditions with regard to fluid properties. The
02:24:45 7 purpose of pore fluid in a pore compressibility measurement is
02:24:52 8 essentially and solely to provide a pressure to the walls of
02:24:55 9 the cores. As such, various different pore fluids can and have
02:25:00 10 been used in the past, and various different fluids are
02:25:03 11 appropriate.

02:25:03 12 Q. Dr. Zimmerman, I'm going to ask the same question because
02:25:06 13 I don't think you answered my question. The testing conditions
02:25:09 14 in the laboratory did not match the in situ conditions in the
02:25:13 15 actual reservoir with respect to the saturation of the cores;
02:25:17 16 isn't that right?

02:25:19 17 MR. FIELDS: Objection. Asked and answered,
02:25:21 18 Your Honor.

02:25:22 19 THE COURT: Overruled.

02:25:23 20 THE WITNESS: Your questions did not match in terms of
02:25:27 21 saturation. In terms of oil/water saturation; is that what
02:25:30 22 you're getting at?

02:25:30 23 EXAMINATION BY MR. GLADSTEIN:

02:25:32 24 Q. Let me try it again, Dr. Zimmerman. The testing
02:25:34 25 conditions in the laboratory did not match the in situ

02:25:39 1 conditions in the actual reservoir with respect to the
02:25:44 2 saturation of the cores; isn't that correct?

02:25:46 3 A. In my experience, that's true in all laboratory
02:25:55 4 pore volume compressibility measurements. I'm not aware of
02:26:00 5 anyone who makes them with in situ reservoir mixture of oil and
02:26:05 6 brine.

02:26:05 7 So the answer is yes, it's not intended to match the
02:26:09 8 properties, and it didn't match the properties, as is
02:26:11 9 universally the case in my experience. That's not the purpose
02:26:16 10 of pore volume compressibility measurement.

02:26:18 11 Q. The in situ saturation of the rock in the
02:26:23 12 Macondo Reservoir is with saltwater or brine; isn't that
02:26:23 13 correct?

02:26:30 14 A. Well, there's brine and hydrocarbon in the
02:26:33 15 Macondo Reservoir, yes.

02:26:33 16 Q. But the testing at Weatherford was done with samples that
02:26:39 17 were cleaned and dried so that the in situ liquid was removed
02:26:45 18 and then saturated with kerosene before the UPVC test; isn't
02:26:45 19 that right?

02:26:51 20 A. As is commonly done in many UPVC tests, yes, that's
02:26:55 21 exactly what they did.

02:26:56 22 Q. The same was done with respect to the ultrasonic velocity
02:27:01 23 measurements, they were tested under dry conditions; isn't that
02:27:05 24 correct?

02:27:07 25 A. That's correct, because that's, in fact, the intention of

02:27:09 1 that test is to measure the dry velocities, yes.

02:27:12 2 Q. Now, in your book under compressibility of sandstones, you
02:27:17 3 suggested a testing procedure that included saturation with
02:27:21 4 brine; isn't that correct?

02:27:22 5 A. I wouldn't say I suggested. I described the procedure
02:27:26 6 that I used in my Ph.D. In those experiments, I did use brine
02:27:30 7 as a saturating fluid. That's certainly also an acceptable
02:27:34 8 procedure to use, yes.

02:27:35 9 Q. In your book, you said that the sample should be dried to
02:27:41 10 remove any moisture from the pore and then afterwards carefully
02:27:47 11 saturated with brine; is that correct?

02:27:49 12 A. That's the method that I use in my Ph.D. experiments,
02:27:53 13 that's correct.

02:27:53 14 Q. You learned about that method from your professor, who had
02:27:58 15 years of experience with this sort of test, as a matter of his
02:28:02 16 protocol; isn't that right?

02:28:06 17 A. Yes, that's correct.

02:28:11 18 I should also say that in my book I do mention many
02:28:13 19 other famous experiments on pore volume compressibility that
02:28:16 20 used kerosene.

02:28:17 21 Q. There were two other mentions of articles in your book
02:28:21 22 where kerosene was used; isn't that right?

02:28:23 23 A. Two of the most famous and important papers in the history
02:28:27 24 of the field of pore volume compressibilities, yes.

02:28:29 25 Q. When you had a Ph.D. student a few years ago who did

02:28:33 1 compressibility measurements, that student used brine as a pore
02:28:39 2 fluid; isn't that right?

02:28:40 3 A. Yes.

02:28:40 4 Q. Now, in your Expert Report, you failed to analyze the
02:28:48 5 effect of testing at saturation conditions different from the
02:28:52 6 in situ saturation conditions of the reservoir; isn't that
02:28:55 7 right?

02:28:55 8 A. I do not believe that the pore fluid will have an effect
02:29:04 9 on the pore volume compressibility as long as that fluid is not
02:29:08 10 something like an acid, obviously, which would eat away the
02:29:11 11 rock grains; but, any sort of sensible fluid that one would
02:29:14 12 use, I don't believe would have an effect on the
02:29:16 13 compressibility.

02:29:17 14 As I said, the purpose of the fluid in the
02:29:19 15 pore volume compressibility test, if we're just focusing on
02:29:22 16 those tests, is merely to apply a pressure. One could, in
02:29:26 17 fact, do that with nitrogen. One doesn't do that for safety
02:29:31 18 reasons, but you could just as well use air or nitrogen.

02:29:34 19 It's just the mechanical effect that one is trying to
02:29:37 20 measure in these pore volume compressibility tests.

02:29:39 21 Q. Thank you.

02:29:42 22 Let's move to the question of temperature. The
02:29:45 23 testing conditions in the Weatherford laboratory did not match
02:29:48 24 the in situ conditions in the actual reservoir with respect to
02:29:50 25 the temperature of the cores; isn't that correct?

02:29:55 1 A. That's correct. The laboratory tests were done at
02:29:59 2 so-called room temperature, which is about 20 degrees C. I
02:30:03 3 believe the reservoir was a temperature of about 110 degrees
02:30:07 4 centigrade.

02:30:08 5 Q. Which is approximately 240 degrees Fahrenheit, right?

02:30:12 6 A. Yes, I think so.

02:30:12 7 Q. In general, compressibility increases as temperature
02:30:17 8 increases; isn't that true?

02:30:18 9 A. Pore compressibility increases very slightly as
02:30:23 10 temperature increases. This was something that I was aware of
02:30:25 11 at the time of writing the report, and I considered it to be a
02:30:27 12 relatively small effect, but it is an effect, yes.

02:30:30 13 Q. The compressibility of a rock will be higher at reservoir
02:30:36 14 temperature than at room temperature; isn't that true?

02:30:39 15 A. It would be slightly higher, yes.

02:30:40 16 Q. In your report, you failed to analyze the effect of
02:30:44 17 testing at temperature conditions different from the in situ
02:30:48 18 temperature conditions of the reservoir; isn't that right?

02:30:51 19 A. I didn't make reference to it because I knew that it would
02:30:54 20 be a relatively small effect. In fact, it is an effect smaller
02:30:59 21 than the -- much smaller than the difference between the
02:31:02 22 measurements that we have on the three cores.

02:31:04 23 So it's an effect of a few percent, well within the
02:31:09 24 range of uncertainty, just from the data that we have.

02:31:14 25 MR. GLADSTEIN: Your Honor, I would move to strike the

02:31:17 1 portion of his answer that talks about the quantification of
02:31:19 2 the effect. That was one of his ten new opinions.

02:31:26 3 THE COURT: Well, I think he was just responding to
02:31:28 4 your question, so I'll overrule your motion.

02:31:32 5 MR. GLADSTEIN: Thank you, Your Honor.

02:31:32 6 EXAMINATION BY MR. GLADSTEIN:

02:31:35 7 Q. Let's turn to BP's usage of 12 microsips for rock
02:31:38 8 compressibility during the well integrity period.

02:31:41 9 You stated in your report, and here in court today,
02:31:44 10 that you did not believe that BP's decision to recommend a new
02:31:48 11 most likely rock compressibility of 12 was consistent with the
02:31:53 12 data; is that correct?

02:31:57 13 A. Yeah, I think roughly speaking that's correct. I didn't
02:32:00 14 see any data that justified that -- that move for changing from
02:32:05 15 a value of six that the data implies to a value of 12, yes.

02:32:09 16 Q. But you listed as considered materials in your report a
02:32:13 17 number of the e-mails between July 6th and July 8th, and the
02:32:19 18 attachments that went with those e-mails, didn't you?

02:32:25 19 A. Yes, I have read some -- many of those e-mails, yes.

02:32:28 20 Q. These e-mails and attachments include UPVC data from other
02:32:32 21 BP wells in the Gulf of Mexico, including Isabela and
02:32:38 22 Santa Cruz, don't they?

02:32:40 23 A. Yes.

02:32:41 24 Q. You didn't consider that data?

02:32:43 25 A. Well, I think I mentioned earlier in my direct testimony

02:32:46 1 that since there is so much variation in pore volume
02:32:51 2 compressibility between one reservoir and the next, I don't
02:32:52 3 believe that the best way to estimate the pore volume
02:32:55 4 compressibility of a given reservoir is by reference to data
02:32:59 5 taken from other reservoirs.

02:33:00 6 Q. So you disregarded that data and the opinions of the BP
02:33:06 7 reservoir engineers and geomechanics who had experience in the
02:33:09 8 Gulf of Mexico, didn't you?

02:33:12 9 A. I'm not sure disregarded is the right word. I considered
02:33:15 10 that point. Based on what I've just said, that I don't believe
02:33:19 11 that one can extrapolate from one reservoir to the next, I
02:33:24 12 didn't believe that measurements made on Isabela or Santa Cruz
02:33:28 13 would be useful, and certainly not more useful than actual data
02:33:34 14 taken from the Macondo Reservoir itself.

02:33:36 15 Q. BP had the same Weatherford core data that you rely on for
02:33:40 16 your opinion, but BP determined that 12 microsips was the most
02:33:45 17 likely value for rock compressibility, didn't they?

02:33:53 18 A. I'm not entirely sure that's the case. Again, my reading
02:33:56 19 of those e-mails was that throughout them Steve Willson, who is
02:34:00 20 their resident rock mechanics expert, was arguing for a value
02:34:04 21 of six. There were a point where the value of 12 was used for
02:34:07 22 certain purposes. I didn't see any scientific justification
02:34:11 23 for that value of 12.

02:34:14 24 So exactly on what basis they made that decision, I'm
02:34:17 25 not sure, but certainly nothing that I've read convinced me

02:34:20 1 that that was a correct scientific decision to ignore the data
02:34:25 2 or modify the data and somehow jump from six to 12.

02:34:29 3 Q. You consider measured data at Macondo to be data; is that
02:34:34 4 correct?

02:34:34 5 A. Yes.

02:34:36 6 Q. Wouldn't you consider measured data at Isabela to be
02:34:42 7 scientific data?

02:34:45 8 A. Scientific data from a different reservoir. As I've
02:34:49 9 mentioned several times, there is so much variation between
02:34:52 10 compressibility of one reservoir to the next.

02:34:54 11 As you can, in fact, see from these graphs that
02:34:56 12 you're alluding to, the range is much larger than the range
02:34:59 13 between six and 12. So, by comparison with other reservoirs,
02:35:03 14 one can get almost any answer, depending on which other
02:35:07 15 reservoir you decide to use as your proxy.

02:35:12 16 Q. You would consider measured data from Santa Cruz to be
02:35:16 17 data, too, wouldn't you?

02:35:18 18 A. By definition, yes.

02:35:19 19 Q. I'm now going to ask you some questions about the relative
02:35:23 20 degree of --

02:35:23 21 THE COURT: Let me ask one question. What was your
02:35:25 22 understanding of why the BP engineers were looking at data from
02:35:33 23 these other wells at that time, from the information you've
02:35:40 24 reviewed?

02:35:42 25 THE WITNESS: Well, obviously, they had a lot of

02:35:44 1 experience from these other wells. These other wells were in
02:35:47 2 the Gulf of Mexico.

02:35:54 3 There did seem to be an implication on the part
02:35:56 4 of some of these people that it was valid to make this type of
02:36:00 5 proxy analog. I think that that's something that one would do
02:36:05 6 in the lack of data, but given actual data, I don't think that
02:36:11 7 in any way proxy data from a different reservoir would sort of
02:36:15 8 trump or supersede data from the reservoir.

02:36:18 9 I can point -- if I can continue for a second,
02:36:20 10 just going back to a very famous paper by Newman, which maybe
02:36:24 11 we haven't discussed here but is mentioned in my report, his
02:36:28 12 main conclusion -- this is one of the most famous papers in
02:36:32 13 this field -- is that if one wants to know the compressibility
02:36:35 14 of a given reservoir, you need to make measurements on the
02:36:38 15 cores of that reservoir.

02:36:39 16 You cannot base it on analogs with other
02:36:42 17 reservoirs or other rock measurements because there is just too
02:36:45 18 much variability from one reservoir to the other.

02:36:47 19 I hope that answers your question.

02:36:50 20 THE COURT: I think so. I'm just trying to understand
02:36:52 21 whether you thought there was some other reason they were doing
02:36:55 22 this, other than to use it as an analog well.

02:36:59 23 THE WITNESS: No, the term "analog well" comes up a lot
02:37:05 24 in their discussion, so it's clear that that's a part of their
02:37:08 25 workflow to base their initial assessment of the new reservoir

02:37:11 1 on ones -- and it only makes sense that -- basing it on other
02:37:16 2 reservoirs that they think are similar.

02:37:18 3 I would point out though that, again, I'm not a
02:37:20 4 geologist, but as I recall, the porosities of these other
02:37:25 5 reservoirs were much larger than the porosity at Macondo.

02:37:29 6 So even to a layman, I'm not sure they would be
02:37:32 7 such good analogs because the porosities, I believe, in these
02:37:36 8 other reservoirs were over 30 percent.

02:37:37 9 But, again, this concept of analog is something
02:37:39 10 that the BP reservoir engineers clearly were accustomed to
02:37:43 11 using in their workflow.

02:37:45 12 MR. GLADSTEIN: Thank you, Your Honor.

02:37:45 13 EXAMINATION BY MR. GLADSTEIN:

02:37:48 14 Q. Now, your statement assumes that rotary sidewall core data
02:37:53 15 is as valid for determining compressibility as whole core data;
02:37:59 16 isn't that correct?

02:38:01 17 A. Well, as I said, there is this issue of anisotropy which
02:38:04 18 has to be considered, so I wouldn't say that rotary
02:38:08 19 sidewall core was completely as useful as whole core, if one
02:38:12 20 had whole core, because, as I said, it does sort of beg the
02:38:16 21 issue or raise the issue of anisotropy.

02:38:18 22 So, yes, there is that issue of anisotropy, which I
02:38:25 23 think I've discussed, which is the one issue that I can see
02:38:27 24 that one has to consider when judging the use -- the
02:38:33 25 applicability of data on rotary sidewall cores.

02:38:35 1 Q. They had whole core at Santa Cruz, didn't they?

02:38:40 2 A. I believe that that's what we've just read, yes.

02:38:43 3 Q. So in your view -- Dr. Zimmerman, we're almost done, and I
02:38:48 4 appreciate --

02:38:48 5 THE COURT: Let me interrupt you. Do we know or do you
02:38:53 6 know and understand why no whole core samples were taken on the
02:38:57 7 Macondo?

02:38:58 8 THE WITNESS: No, I don't know for certain why that --
02:39:06 9 there was some discussion of it in some of the BP documents. I
02:39:10 10 don't know. I was not involved in that discussion.

02:39:14 11 THE COURT: Okay. All right. Go ahead.

02:39:17 12 MR. GLADSTEIN: Thank you, Your Honor.

02:39:18 13 Almost at the end, and I appreciate both of your
02:39:20 14 patience on this.

02:39:20 15 EXAMINATION BY MR. GLADSTEIN:

02:39:22 16 Q. As you stated on your direct, Dr. Zimmerman, it's your
02:39:26 17 view that the Macondo Reservoir rock falls into the range of
02:39:30 18 weekly consolidated sandstone; isn't that true?

02:39:36 19 A. Yes. That's what I stated at my deposition, yes.

02:39:37 20 Q. If we could bring up defendants deposition D-23953, I
02:39:44 21 would appreciate it. Demonstrative. Can we do that? This is
02:40:11 22 D-23953. Yes, thank you.

02:40:28 23 Now, in this demonstrative that you were shown on
02:40:31 24 direct, the heading is "Unconsolidated Sands Have Very Low
02:40:36 25 Acoustic Velocities." You placed Macondo with a star there in

02:40:44 1 the area of the yellow triangles; isn't that correct?

02:40:50 2 MR. FIELDS: Just for the record, Your Honor, we did
02:40:51 3 not use this on direct examination.

02:40:54 4 MR. GLADSTEIN: Oh, sorry, I apologize. It was one of
02:40:57 5 the ones that they provided to us.

02:40:58 6 MR. FIELDS: The rule is I've got to use it first.

02:41:03 7 MR. GLADSTEIN: Oh, okay, I apologize, if that's the
02:41:05 8 rule.

02:41:06 9 THE COURT: Apparently, that's the rule.

02:41:11 10 MR. BROCK: I'm sorry, as I mentioned, we have a
02:41:12 11 demonstrative coach, and he works with us, like, weekly, to
02:41:16 12 keep us up to speed.

02:41:16 13 EXAMINATION BY MR. GLADSTEIN:

02:41:26 14 Q. Isn't it true that based on procedures from the
02:41:28 15 Weatherford labs, these cores were treated as friable or
02:41:31 16 unconsolidated when they were recovered?

02:41:37 17 THE COURT: Was the word "friable"?

02:41:42 18 MS. HIMMELHOCH: Friable, yes.

02:41:42 19 EXAMINATION BY MR. GLADSTEIN:

02:41:44 20 Q. Would you define for Your Honor the term "friable,"
02:41:46 21 please.

02:41:46 22 A. Friable is an operational term that goes back to a paper
02:41:51 23 by George Newman from Chevron in 1973. He categorized
02:41:55 24 sandstones in three categories of consolidated at one extreme,
02:42:04 25 unconsolidated at the other extreme -- unconsolidated, again,

02:42:05 1 being a loose collection of sand grains -- but what he called
02:42:09 2 friable was a situation where the rock had enough sort of
02:42:12 3 coherence and a high enough level of consolidation that one
02:42:14 4 could create a core and sit it on the table, but, yet, at the
02:42:18 5 same time it was sufficiently weak that one could, by rubbing
02:42:22 6 ones finger against it, break off some of the sand grains or
02:42:27 7 break off a corner.

02:42:28 8 So friable category is somewhere between consolidated
02:42:31 9 and unconsolidated. I think, for practical purposes, it's
02:42:36 10 somewhat equivalent to what other people would call weakly
02:42:40 11 consolidated.

02:42:43 12 Q. You are aware that Weatherford had well site procedures
02:42:47 13 for handling the Macondo sidewall cores; isn't that right?

02:42:50 14 A. Yes.

02:42:51 15 Q. Now these procedures stated, "If it is determined that the
02:42:55 16 cores are unconsolidated during the initial sample assessment,
02:42:58 17 then the cores will be frozen in the receiver tube using a
02:43:03 18 procedure"; isn't that right? Do you recall that?

02:43:06 19 A. I recall reading that, yes, I do.

02:43:07 20 Q. Do you recall that the Macondo sidewall cores were frozen
02:43:13 21 after they were extracted?

02:43:15 22 A. Yes, I do recall that.

02:43:17 23 Q. Isn't it also true that Weatherford noted that numerous
02:43:22 24 Macondo samples that had been recovered were fractured, broken,
02:43:29 25 and in remnants?

02:43:30 1 A. Yes, I do recall that. I think that's very common with
02:43:36 2 core recovery from all sorts of reservoirs, that some of the
02:43:40 3 core is damaged and not usable, yes.

02:43:42 4 Q. Now, to clear up one last point related to BP's rock
02:43:52 5 mechanics expert Stephen Willson, if we could bring up
02:43:57 6 TREX-8774.001, please.

02:44:10 7 Thank you. If we could highlight the last sentence
02:44:27 8 in the e-mail at the top -- the second to the last sentence.

02:44:30 9 So this is an e-mail from Mr. Willson, who was the BP
02:44:39 10 rock mechanics expert, to David Schott, July 6, 2010, re:
02:44:45 11 Macondo PVC.

02:44:48 12 In this sentence, Mr. Wilson says, "The initial
02:44:53 13 response," in other words, the initial response related to, you
02:44:57 14 know, we should stay with six, "was more to do with what we
02:45:01 15 measured on the Macondo rotary side wall cores, which, as you
02:45:06 16 correctly point out, have some inherent biases."

02:45:11 17 As you've indicated, rotary side wall cores can have
02:45:15 18 inherent biases, can't they, Dr. Zimmerman?

02:45:18 19 A. Well, as I pointed out, if the rock is anisotropic, then
02:45:25 20 one would measure sort of an improper value. As I mentioned
02:45:28 21 earlier, based on the other data that I've looked at, I don't
02:45:31 22 see any evidence that these rocks were highly anisotropic.

02:45:39 23 That raises one more point. I've look at lots of
02:45:39 24 such data over the years, and I honestly don't recall ever
02:45:42 25 seeing sandstones that have anisotropy factors of a factor of

02:45:47 1 two. I've never seen such laboratory data.

02:45:50 2 Q. The same Weatherford data is the same data that
02:45:54 3 Mr. Willson and other BP reservoir engineers looked at and
02:45:58 4 determined that the most likely pore volume compressibility for
02:46:02 5 the Macondo rock was 12; isn't that correct?

02:46:09 6 A. Well, strictly speaking, I'm not sure that Steve Willson
02:46:11 7 ever -- from my reading of the document, I'm not sure he ever
02:46:13 8 agreed with that.

02:46:14 9 My interpretation was that he was acquiescing to that
02:46:20 10 value, which was being sort of pressured on him to some extent.
02:46:24 11 So him being their actual resident rock mechanics expert, I
02:46:28 12 think the evidence shows that he was trying to stick to the
02:46:30 13 value of about six.

02:46:34 14 Q. Let's see if this refreshes your recollection.

02:46:37 15 Could we please turn to TREX-8776.001. If you could
02:46:50 16 highlight the -- one, two -- third e-mail on this page, the one
02:46:55 17 from Kelly McAughan to Stephen Willson.

02:47:00 18 Do you recall looking at the e-mail that said -- from
02:47:05 19 Kelly McAughan to Stephen Willson, the rock mechanics expert,
02:47:09 20 "How about if we use 6, 12 and 18?" Do you recall that,
02:47:12 21 Dr. Zimmerman?

02:47:12 22 A. Yes, I certainly do recall this.

02:47:13 23 Q. Thank you.

02:47:14 24 Do you recall what the rock mechanics expert
02:47:16 25 responded, in the e-mail right above that?

02:47:19 1 Let's turn to that, please. Okay.

02:47:29 2 He stated, "That sounds very reasonable to me,
02:47:32 3 Kelly." Do you recall that, Dr. Zimmerman?

02:47:34 4 A. This is completely consistent with my interpretation that
02:47:36 5 he was essentially acquiescing to this after several days of
02:47:43 6 him saying -- it was a quote which I'm sure you remember in one
02:47:46 7 of his earlier e-mails saying, I don't think we could go much
02:47:50 8 above six and still honor the data.

02:47:52 9 Then, after a few days of e-mails, he said, okay,
02:47:55 10 sounds reasonable to me. I interpret that as saying, okay, I'm
02:47:58 11 not going to argue it anymore because I've been overruled.

02:48:01 12 But anyway, getting back to my opinion, again, I
02:48:06 13 would like to emphasize, I still don't see any discussion here
02:48:10 14 that convinces me that the rotary sidewall core value should be
02:48:14 15 multiplied by a factor of two.

02:48:17 16 MR. GLADSTEIN: Those are my questions, Dr. Zimmerman.

02:48:18 17 Thank you, Your Honor.

02:48:20 18 THE COURT: All right, sure.

02:48:21 19 Redirect.

02:48:23 20 MR. FIELDS: No redirect, Your Honor.

02:48:24 21 THE COURT: Okay. Thank you, sir. You're done.

02:48:27 22 THE WITNESS: All right. Thank you.

02:48:31 23 THE COURT: Who is the next witness for defendants?

02:48:37 24 MR. BROCK: Your Honor, our next witness is
02:48:38 25 Dr. Gringarten, and I think he's in the hall. I'll step out.

02:48:42 1 THE COURT: Why don't we stop off and take about a
02:48:45 2 10- or 15-minute recess.

02:48:48 3 THE DEPUTY CLERK: All rise.

03:10:44 4 (WHEREUPON, at 2:48 p.m., the Court was in recess.)

03:10:44 5 THE DEPUTY CLERK: All rise.

03:10:46 6 THE COURT: Please be seated, everyone.

03:11:02 7 Is someone going to examine this witness?

03:11:08 8 MR. BOLES: Yes, Your Honor. I was obeying your
03:11:13 9 directive to be seated.

10 THE COURT: I didn't mean permanently.

11 THE DEPUTY CLERK: Would you please raise your right
12 hand. Do you solemnly swear that the testimony you are about
13 to give will be the truth, the whole truth and nothing but the
14 truth, so help you God?

15 THE WITNESS: I do.

16 **ALAIN GRINGARTEN**

17 was called as a witness and, after being first duly sworn by
18 the Clerk, was examined and testified on his oath as follows:

19 THE DEPUTY CLERK: If you'll take a seat, and please
20 state and spell your name for the record.

03:11:23 21 THE WITNESS: My name is Alain Gringarten

03:11:28 22 G-R-I-N-G-A-R-T-E-N.

03:11:33 23 MR. BOLES: Dr. Gringarten, I think you better spell
03:11:35 24 your first name, as well, given your country of origin.

03:11:36 25 THE WITNESS: A-L-A-I-N.

03:11:41 1 MR. BOLES: Your Honor, Martin Boles on behalf of BP
03:11:43 2 and Anadarko. If I may proceed?

03:11:45 3 THE COURT: Yes.

03:11:45 4 VOIR DIRE EXAMINATION BY MR. BOLES:

03:11:48 5 Q. Dr. Gringarten, can you tell Judge Barbier what you were
03:11:52 6 asked to do for BP in this case.

03:11:53 7 A. I was asked to evaluate the total discharge from the
03:12:00 8 Macondo Well.

03:12:00 9 Q. Let's review a little bit about your background that
03:12:08 10 prepared you for this.

03:12:09 11 Let's go to D-23614.

03:12:13 12 Where did you get your education related to your work
03:12:16 13 here, Dr. Gringarten?

03:12:17 14 A. I have an MSc and PhD from Stanford University. Then I
03:12:24 15 was a research fellow at the University of California at
03:12:27 16 Berkeley.

03:12:28 17 Q. That's a research fellow?

03:12:29 18 A. Yes.

03:12:30 19 Q. Where do you work now?

03:12:31 20 Let's look at D-23616.

03:12:36 21 A. I'm a professor of petroleum engineering at
03:12:40 22 Imperial College.

03:12:41 23 Q. Imperial College.

03:12:43 24 Have you had any leadership positions there?

03:12:45 25 A. Yes, I'm the Director of the Centre for Petroleum Studies

03:12:48 1 and I'm the chair of petroleum engineering.

03:12:50 2 Q. Did you go directly from your Stanford and Berkeley
03:12:55 3 graduate and postgraduate work to academia?

03:12:59 4 A. No. I spent 25 years in industry.

03:13:03 5 Q. Let's look at an overview of that. D-23615.

03:13:10 6 Can you summarize your work in industry before you
03:13:13 7 went to Imperial College?

03:13:16 8 A. I spent five years -- well, initially, I spent four years
03:13:20 9 with the French Geological Survey. Then I spent five years in
03:13:31 10 Schlumberger.

03:13:31 11 THE REPORTER: I'm sorry?

03:13:31 12 THE WITNESS: In Schlumberger, S-C-H --

03:13:31 13 THE REPORTER: Oh, Schlumberger.

03:13:32 14 THE WITNESS: Yeah, okay.

03:13:37 15 THE COURT: That's how we pronounce it down here.

03:13:42 16 THE WITNESS: We might have a few of these.

03:13:45 17 THE COURT: Go ahead.

03:13:45 18 THE WITNESS: Then I spent 14 years with Scientific
03:13:50 19 Software - Intercomp before joining Imperial College.

03:13:53 20 EXAMINATION BY MR. BOLES:

03:13:53 21 Q. After joining Imperial College, did you continue to do
03:13:58 22 consulting work for industry?

03:13:58 23 A. Yes. I've been, you know, very active in consulting for
03:14:04 24 oil industry on essentially well test analysis issues.

03:14:09 25 Q. Now, we're going to be talking a lot about well test

03:14:13 1 analysis. Can you briefly summarize what that is.

03:14:15 2 A. Well, in short, well test analysis is a study of pressure
03:14:19 3 and rate to obtain permeability and other information that
03:14:25 4 characterize the reservoir.

03:14:26 5 Q. Was well test analysis part of the work you did to analyze
03:14:31 6 the Macondo Well and come up with a cumulative flow estimate?

03:14:36 7 A. Yes.

03:14:37 8 Q. Let's go back to the earlier work you did in industry
03:14:39 9 after you left your postgraduate work at Berkeley.

03:14:43 10 Under Schlumberger, in the third bullet point, it
03:14:48 11 says, "Founded well test analysis service." Can you describe
03:14:51 12 for Judge Barbier what that refers to.

03:14:52 13 A. I was hired by Schlumberger to create surveys with
03:15:01 14 engineers that would conduct well tests for their clients.

03:15:04 15 The reason I was hired was because I had published a
03:15:07 16 number of papers on well test analyses prior to that. So what
03:15:12 17 I did there is set up a service that would include -- you know,
03:15:17 18 defining the service, training the engineers, develop the
03:15:35 19 methodology -- training the engineers, developing methodology,
03:15:35 20 you know, and defining the complete service provided to the
03:15:40 21 clients.

03:15:40 22 Q. Prior to that, what had Schlumberger and other service
03:15:46 23 companies in the oil industry done with respect to well test
03:15:49 24 analysis?

03:15:50 25 A. Prior to that, they were not doing interpolation. What

03:15:58 1 the service company was doing is taking measurements and
03:16:00 2 providing the measurements to the clients, and they thought
03:16:04 3 that the responsibility for interpreting the data was with the
03:16:11 4 clients.

03:16:12 5 Then in 1978, they decide to, you know, go further
03:16:17 6 and provide interpreted data to the client, and that's where,
03:16:23 7 you know, I was hired.

03:16:24 8 Q. In the second main bullet point there in your industry
03:16:34 9 experience, Scientific Software - Intercomp, the last
03:16:39 10 sub-bullet says, "Developed first commercial well test analysis
03:16:41 11 software." Can you describe a little bit more about that for
03:16:44 12 Judge Barbier.

03:16:45 13 A. Yes. Only certain operating companies had their own
03:16:54 14 software for doing different things, including interpreting
03:16:59 15 well tests data. I developed such a software when I was in
03:17:06 16 Schlumberger for the well test analysis service.

03:17:10 17 I redeveloped it in Scientific Software, with the
03:17:14 18 objective of selling it to oil companies. So the first
03:17:21 19 software -- that was the first software that was sold to --
03:17:26 20 that became commercial in 1983.

03:17:29 21 Q. Does that software still exist as a commercial product?

03:17:34 22 A. Yes. It is called Interpret. That's a software which I
03:17:39 23 have used for doing the work I've done for BP.

03:17:44 24 Q. Let's go to D-23617.

03:17:48 25 We've summarized, Dr. Gringarten, some of your

03:17:51 1 professional contributions on this slide. We won't go over all
03:17:58 2 of them, but if you could tell Judge Barbier about the third
03:18:01 3 bullet, "Standardized well test analysis methodology."

03:18:08 4 A. Yes. That was part of the work that I did for creating
03:18:14 5 well test analysis software -- sorry, I managed the service in
03:18:20 6 Schlumberger.

03:18:20 7 What I wanted is to -- something that the engineer
03:18:25 8 doing -- interpreting well test data, pressure and grade, would
03:18:29 9 have confidence in their analyses, and also the clients would
03:18:39 10 be confident in the analysis they received.

03:18:43 11 So I developed a number of check and balance because
03:18:46 12 the problem was with techniques that existed until then, the --
03:18:52 13 those -- there were a number of methods of interpreting tests,
03:18:56 14 but they were not used consistently. So you could have widely
03:19:02 15 different result of the well test analyses depending on what
03:19:08 16 method used.

03:19:09 17 So, therefore, the well test analyses was not really
03:19:15 18 reproducible, and people were not confident in the results of
03:19:22 19 these analyses.

03:19:22 20 What I did is reorganized the various interpretation
03:19:26 21 technique so that it became consistent. The result was that if
03:19:31 22 you give well test data to somebody, and they follow -- to
03:19:36 23 several people, and they follow that -- they will get the same
03:19:40 24 result, which is something that was not available before.

03:19:44 25 Q. Have you applied in this case, Dr. Gringarten, what you

03:19:49 1 just described, this system of checks and balances, to compare
03:19:53 2 one methodology with another methodology as a consistency check
03:19:57 3 on the reliability of your work?

03:19:59 4 A. Yes.

03:19:59 5 Q. Let's skip to the last bullet point that says,
03:20:03 6 "Deconvolution." Since we're going to be hearing a little bit
03:20:09 7 more about that in the next few minutes, why don't you describe
03:20:10 8 briefly for Judge Barbier what that is.

03:20:11 9 A. Deconvolution is a method -- it's a mathematical tool, and
03:20:18 10 it's a method of processing the data so that you can use all of
03:20:22 11 the data from the test, not a few data points, for obtaining
03:20:30 12 information from the well test.

03:20:33 13 We developed that in my team, and that allowed us to
03:20:38 14 see, you know, very far into the reservoir, in fact, to see
03:20:41 15 everything that has been reached by the pressure signal.

03:20:44 16 Q. Is that now a standard tool in the petroleum industry?

03:20:48 17 A. Yes. It has been -- we developed that tool in the year
03:20:53 18 2001, 2002. It has been incorporated in all the existing
03:20:59 19 well test interpretation software starting in 2006.

03:21:07 20 MR. BOLES: Your Honor, at this time BP would tender
03:21:12 21 Dr. Gringarten as an expert in petroleum engineering and
03:21:12 22 well test analysis.

03:21:13 23 THE COURT: No objections. Okay, he's accepted.

03:21:13 24 DIRECT EXAMINATION BY MR. BOLES:

03:21:18 25 Q. Dr. Gringarten, did you prepare a report describing your

03:21:22 1 calculations and supporting work in this case?

03:21:23 2 A. Yes.

03:21:23 3 Q. D-24660, please.

03:21:29 4 Is this the cover page of your Expert Report?

03:21:31 5 A. Yes.

03:21:33 6 MR. BOLES: Your Honor, we would offer Dr. Gringarten's
03:21:35 7 report, which is TREX-11696R, into evidence.

03:21:42 8 THE COURT: All right, it's admitted.

03:21:42 9 (WHEREUPON, Exhibit TREX-11696R was admitted into
03:21:42 10 evidence.)

03:21:42 11 EXAMINATION BY MR. BOLES:

03:21:44 12 Q. Dr. Gringarten, at a high level can you describe the basic
03:21:48 13 sequence of analysis and work you did to estimate cumulative
03:21:53 14 flow?

03:21:54 15 A. Well, I have done it in two steps. One is I have
03:22:01 16 calculated permeability from data measured at the reservoir
03:22:09 17 level before the spill. Then I've used that permeability and
03:22:16 18 pressure measured during the spill and during the shut-in
03:22:20 19 following the spill to calculate the rate during the spill from
03:22:24 20 which I could calculate the total discharge.

03:22:27 21 Q. Let's look at a summary of your opinions on those two
03:22:32 22 stages, D-24661.

03:22:36 23 Can you summarize for Judge Barbier the opinions
03:22:39 24 you've arrived at in this case.

03:22:41 25 A. Yes, I've found that the permeability of the reservoir is

03:22:44 1 238 millidarcies, and that the cumulative discharge of oil is
03:22:50 2 between 2.4 and 3 million stock-tank barrels.

03:22:53 3 Q. Let's turn first to the first of those opinions, your
03:22:59 4 determination of the permeability of the Macondo Reservoir.

03:23:04 5 What method did you use to estimate that
03:23:06 6 permeability?

03:23:06 7 A. Well, I've used well test analysis.

03:23:11 8 Q. Let's look at an overview of well test analysis at
03:23:19 9 D-23599-1.

03:23:19 10 What does this teach us about well test analysis,
03:23:23 11 Dr. Gringarten?

03:23:24 12 A. Well test analysis is a study of the relationship between
03:23:29 13 pressure, flow rates and permeability. In the normal
03:23:32 14 well tests, the flow rates and the pressure are measured, and
03:23:37 15 then you can calculate the permeability. But this figure
03:23:42 16 showed that if you know two of the quantities, then you can
03:23:46 17 calculate the third one.

03:23:47 18 So if you know the permeability and if you know the
03:23:50 19 pressure, then you can calculate the flow rate.

03:23:52 20 Q. Let's quickly review what permeability is.

03:23:56 21 Let's go to D-23596A.

03:23:59 22 Can you describe for Judge Barbier, what is this
03:24:01 23 property of permeability?

03:24:05 24 A. Okay. What we have here, we have done two representations
03:24:07 25 of a reservoir that's at the, you know, micro scale. We have

03:24:15 1 in brown, these are the sand grains. In gray, we have the pore
03:24:24 2 space between the grains.

03:24:25 3 We have more conductivity in this figure on the
03:24:29 4 right-hand side than we do on the left-hand side. So this
03:24:34 5 reservoir here is less permeable than this reservoir there.
03:24:40 6 The consequence is that the -- permeability characterize how
03:24:44 7 easy it is for fluid to flow through a formation. So it's more
03:24:48 8 difficult to flow -- for the fluid to flow in this in the
03:24:52 9 left-hand side, than it is on the right-hand side.

03:24:55 10 The rate of production is proportional to
03:24:59 11 permeability. So if you double the permeability, then you
03:25:04 12 double the flow rate. That's the reason permeability is a key
03:25:07 13 to understanding the flow rate.

03:25:08 14 Q. Is there a name, Dr. Gringarten, in the petroleum industry
03:25:12 15 for this relationship between flow rate and permeability and
03:25:16 16 pressure?

03:25:19 17 A. Well, the --

03:25:21 18 Q. Sorry to interrupt you. Let's go to D-23599A.

03:25:27 19 A. The flow rate, permeability and pressure change are linked
03:25:32 20 by what is called Darcy's law. Darcy's law was developed by
03:25:48 21 Mr. Darcy in 1851. He proved experimentally that the flow rate
03:25:59 22 was proportional to something that he calls the permeability
03:26:02 23 and the pressure differential in the reservoir.

03:26:06 24 Q. I see you have a little flag emblem there. Where was
03:26:10 25 Mr. Darcy from?

03:26:11 1 A. He was French.

03:26:14 2 He developed that study -- he had to study the flow
03:26:19 3 of the fountains in the town of Dijon, which is known for the
03:26:30 4 mustard, and that's how he came up with that relationship,
03:26:33 5 which he found experimentally.

03:26:36 6 Q. Now, have you worked with Darcy's law in your past work in
03:26:39 7 well test analysis petroleum engineering?

03:26:42 8 A. Darcy's law is the fundamental law for flow in porous
03:26:48 9 media, so that's what we work with.

03:26:50 10 Q. Now, Judge Barbier has heard about another fundamental law
03:26:54 11 involved in reservoir engineering called the material balance
03:26:58 12 equation. Can you compare or describe the relationship between
03:27:04 13 Darcy's law and the material balance equation?

03:27:07 14 A. Material balance is about conservation of mass, which says
03:27:10 15 that if you have a certain volume what comes out is equal to
03:27:15 16 what came in, minus what stays in.

03:27:19 17 The Darcy's law is more about the flux that goes
03:27:24 18 through the volume. If we take an analogy in finance, for
03:27:28 19 instance, the material balance will be the balance sheet, and
03:27:31 20 Darcy's law would be the income statement.

03:27:33 21 Q. Now, let's look at how you applied Darcy's law to your
03:27:40 22 work in Macondo, if we can go to the next slide.

03:27:48 23 How did you use these relationships in starting your
03:27:53 24 analysis of permeability?

03:27:55 25 A. Well, first, I used flow rate and pressure measured prior

03:28:02 1 to the spill at the bottom of the well to calculate
03:28:07 2 permeability.

03:28:10 3 Q. How did you get flow rate and pressure measured prior to
03:28:13 4 the spill at the reservoir?

03:28:16 5 A. There is a tool that has been used which is called the MDT
03:28:22 6 tool, which was run on April 12th, and which gathered flow rate
03:28:31 7 and pressure through an experiment at the bottom of the well.

03:28:35 8 Q. Let's look quickly at D-23600.

03:28:40 9 Does this summarize this next step that you're going
03:28:44 10 to describe with the MDT tool?

03:28:46 11 A. Correct.

03:28:47 12 Q. Now, let's have you tell us a little bit about the MDT
03:28:48 13 tool. Let's go to D-23604-1B.

03:28:53 14 What is an MDT tool, Dr. Gringarten?

03:28:56 15 A. What we have here is, you know, the schematic of the
03:29:01 16 reservoir. So the brown, the dark ribbon vertical is
03:29:07 17 representing the well. The gold brown horizontal represents
03:29:11 18 the reservoir.

03:29:12 19 The MDT tool is a trademark of Schlumberger. The
03:29:18 20 general term is wireline formation tester. So that tool is
03:29:23 21 lowered at the bottom of the well with a cable, an x-ray cable,
03:29:29 22 and it's located near at the reservoir. The probe is inserted
03:29:34 23 into the reservoir and --

03:29:39 24 So initially the fluid is contaminated by the mud
03:29:43 25 during drilling. As you keep pumping, the signal extends into

03:29:48 1 the reservoir, and the fluid becomes less and less contaminated
03:29:54 2 until you get the reservoir fluid, which is then taken as
03:29:58 3 sample for PVC analysis.

03:30:00 4 Q. What are we looking at in this zoom-out of that
03:30:09 5 demonstrative?

03:30:10 6 A. Well, this represent how far the pressure signal has
03:30:14 7 reached in the formation. In the PVC test that I have
03:30:21 8 calculated, we reached about 600 feet, which is about half the
03:30:25 9 distance to the closest boundary of the reservoir.

03:30:30 10 So the zone investigated is quite large, and,
03:30:34 11 therefore, the permeability we calculated from the pressure and
03:30:36 12 the rate measurements of two are representative of the
03:30:41 13 permeability of the reservoir.

03:30:43 14 Q. How long does that -- we saw a speeded-up version of that
03:30:47 15 process. How long does that pumping go on in gathering the
03:30:51 16 sample from the reservoir that we just saw represented?

03:30:55 17 A. Three to four hours.

03:30:56 18 Q. What's the importance of that?

03:31:00 19 A. Well, as I said, the longer you pump, the further away the
03:31:06 20 pressure signal goes, and therefore the larger the zone of the
03:31:12 21 reservoir which is investigated, you know, during the test.
03:31:16 22 Therefore, the larger zone is more representative of the
03:31:21 23 permeability you calculate from the data.

03:31:23 24 Q. Now, what data are you getting from the procedure we just
03:31:28 25 looked at?

03:31:30 1 Let's go to D-23604-2.

03:31:34 2 A. Well, what we have at the top here is a graph. Time is on
03:31:41 3 the Y axis. We have pressure on the X axis. So as we pump,
03:31:48 4 the pressure is recorded, and the rate is recorded as well. So
03:31:52 5 in blue we have the pressure versus time as we are pumping, and
03:31:58 6 we have the rate in green versus time.

03:32:01 7 So this information is being recorded during the
03:32:05 8 pumping, and that's what we use for doing the well test
03:32:08 9 analysis.

03:32:09 10 Q. This recording of pressure and rate at the same time was
03:32:14 11 done on what date?

03:32:16 12 A. That was done in April the 12th -- on April the 12th.

03:32:18 13 Q. Is this the only collection of rate and pressure
03:32:25 14 information taken directly at the reservoir prior to the
03:32:30 15 incident?

03:32:30 16 A. Yes.

03:32:31 17 Q. Are you the only expert in this case, up until the
03:32:37 18 rebuttal reports, who used this information to try to estimate
03:32:40 19 permeability?

03:32:40 20 A. Yes.

03:32:40 21 Q. Now, let's go -- let's look at the data that is depicted
03:32:48 22 from the MDT test. What data are you going to use there in
03:32:52 23 your analysis to calculate permeability?

03:32:54 24 A. Well, what we have in blue here is complete recording
03:33:03 25 during the pumping. Whenever the rate decreased, then the

03:33:10 1 pressure goes up.

03:33:13 2 From time to time, the tool has been shut, and the
03:33:19 3 pressure -- the rate becomes zero, and so the pressure goes up.
03:33:22 4 This is what we call buildup. So there are a number of
03:33:26 5 buildups, which I have analyzed with focus on the very last
03:33:31 6 one.

03:33:31 7 Q. What does a buildup of pressure do, Dr. Gringarten? I
03:33:36 8 would ask you to refer to the bottom part of this diagram,
03:33:39 9 those pressure signals that you described earlier.

03:33:43 10 A. Well, the buildup is when the -- you shut the tool. The
03:33:50 11 signal pressure, you know, keeps going on, even during this
03:33:54 12 buildup.

03:33:56 13 Q. Now let's take a look at another diagram to illustrate how
03:34:00 14 you analyze that pressure signal during a buildup going through
03:34:04 15 the reservoir. D-24676.

03:34:09 16 Can you describe for Judge Barbier how this
03:34:14 17 representation of a pressure signal gives you information that
03:34:17 18 you use to calculate permeability.

03:34:19 19 A. Okay. What we -- what we have here is a schematic of the
03:34:27 20 reservoir, so that's the well. Here we have the boundary of
03:34:31 21 the reservoir, so this brown is the reservoir. This is the
03:34:34 22 well.

03:34:34 23 When we start producing, then the pressure signal
03:34:41 24 goes away from the well. Initially it is, you know, radial,
03:34:47 25 and so we have radial flow. What we look at is the rate of

03:34:55 1 change of the pressure versus time, which is the derivative.

03:35:00 2 Q. Where is that on that diagram?

03:35:01 3 A. This is the derivative here, where we plot the derivative
03:35:05 4 versus time. The derivative exhibit the shape, which
03:35:11 5 characterize a reservoir.

03:35:13 6 So at the beginning, we have something that
03:35:16 7 characterize what is in the well or very close to the well.
03:35:19 8 Then when we develop this radial flow, we have stabilization
03:35:27 9 from which we can calculate the permeability, and then we have
03:35:31 10 the boundary. Where we see those two boundaries, that's this
03:35:34 11 signal here, where there was -- what we call channel flow.

03:35:38 12 Then, when we reach the end of the reservoir, then we
03:35:41 13 have a different signal here, which we call a closed reservoir.

03:35:46 14 So the derivative allows us to see exactly, you know,
03:35:50 15 what the reservoir is and how it behaves.

03:35:53 16 Q. Now, which part of that derivative plot at the bottom of
03:35:58 17 pressure change over time, which part of that plot do you look
03:36:02 18 at to -- in your calculation of permeability?

03:36:07 19 A. The permeability is given by the flat part here. That's
03:36:11 20 what I have used in my analysis. As a by-product, you know, I
03:36:17 21 get everything, but essentially my objective was to obtain this
03:36:22 22 part here and calculate the permeability.

03:36:24 23 Q. That's the flat radial flow period?

03:36:28 24 A. Correct.

03:36:28 25 Q. Now, let's take a look at that in a simplified way as it

03:36:33 1 relates to your calculation of permeability. Let's go to
03:36:37 2 D-24662.

03:36:39 3 This is the pictures we had earlier of low and high
03:36:45 4 permeability. How are those then represented in what you look
03:36:48 5 for in the derivative plot or pressure?

03:36:52 6 A. So these are -- this is the -- on the left-hand side, we
03:36:56 7 have the low permeability reservoir. On the right-hand side,
03:37:00 8 we have the high permeability reservoir.

03:37:02 9 The shape of the derivative, which we have here and
03:37:06 10 there, are the same. The difference between the two is that
03:37:09 11 the stabilization from which we calculate the permeability
03:37:13 12 would be higher for the low permeability reservoir than for the
03:37:18 13 higher permeability reservoir.

03:37:19 14 Q. So a lower permeability has a higher radial flow
03:37:23 15 stabilization on the derivative plot?

03:37:25 16 A. That's correct.

03:37:26 17 Q. The higher permeability has a lower radial flow
03:37:31 18 stabilization flatness on the derivative plot?

03:37:34 19 A. This is correct.

03:37:34 20 Q. Now, let's take these concepts and these simplified plots,
03:37:37 21 and let's look at the actual data plotted as a pressure
03:37:41 22 derivative from this MDT test. D-24665.

03:37:46 23 Explain to Judge Barbier what this is,
03:37:49 24 Dr. Gringarten, and how you used it to calculate permeability.

03:37:53 25 A. So what we see here, the triangle in blue represents

03:37:58 1 derivative data. So these are the data of the derivative of
03:38:02 2 one of the tests.

03:38:04 3 We can see here that the data stabilized in this
03:38:08 4 region. We have something which is flat here. That's what is
03:38:12 5 used for doing the analysis.

03:38:15 6 The result of the analysis is this red curve here,
03:38:23 7 which -- you know, whereas the flat part goes through the data,
03:38:24 8 and, in fact, it's fitted by nonlinear regression to the data.

03:38:38 9 Q. Dr. Gringarten, that nonlinear regression that you used to
03:38:45 10 fit that red curve to the data so you can calculate
03:38:48 11 permeability, is that commonly used in the petroleum industry
03:38:52 12 for this kind of analysis?

03:38:53 13 A. Yes. That's standard in all the well test interpretation
03:38:58 14 software.

03:38:58 15 Q. That's well test interpretation software?

03:39:01 16 A. Yes.

03:39:02 17 Q. How many times in your career have you used a derivative
03:39:07 18 analysis like this and fitting a curve in it to calculate a
03:39:13 19 permeability for an oil company client?

03:39:18 20 A. The derivative approach has been developed in 1983, and so
03:39:22 21 I've used it since then. It's what you use in doing well test
03:39:27 22 interpretation.

03:39:27 23 Q. Rough ballpark figure the number of times you've used this
03:39:31 24 method for oil company clients in your consulting?

03:39:33 25 A. A few thousand.

03:39:35 1 Q. Now, we can see that there are some blue triangles above
03:39:42 2 and below your red line. What's your analysis of that for
03:39:48 3 Judge Barbier?

03:39:48 4 A. Well, this represents a scattering of the data. You know,
03:39:52 5 you have better data than that usually, or you could have, you
03:39:57 6 know, worse detail than that. That's not unusual.

03:40:01 7 So what we can do with that is account for the
03:40:06 8 scattering in the uncertainty analysis, because we could
03:40:14 9 imagine that we could have drawn that red stabilization above
03:40:18 10 the data, and we could have drawn it below the data, and that
03:40:22 11 range, you know, is a range that we can calculate the
03:40:26 12 uncertainty on the permeability.

03:40:28 13 Q. We'll look momentarily at how you treated that uncertainty
03:40:32 14 in terms of your quantification of permeability, but I want to
03:40:39 15 focus on that scatter that you just referred to. Is that about
03:40:41 16 a scatter around the red line that you fitted to the data, is
03:40:44 17 that something you've ever experienced before in your prior
03:40:47 18 well test analysis work?

03:40:48 19 A. Yes.

03:40:48 20 Q. How many times would you say you've seen data plotted in a
03:40:55 21 derivative analysis that has that much scatter?

03:40:58 22 A. In general, you prefer to interpret data that have a lot
03:41:02 23 less scatter, but you don't have control of that. So, you
03:41:05 24 know, sometimes you have less scatter, you have more scatter.
03:41:10 25 I would say maybe 20 percent of the case, 25 percent of the

03:41:13 1 cases are, you know, similar to that.

03:41:16 2 Q. 25 percent of the thousands of cases?

03:41:18 3 A. Yes, yes.

03:41:18 4 Q. Now, in the 30 years you've been doing this for industry
03:41:23 5 clients using this kind of derivative analysis and the hundreds
03:41:26 6 of times that you've confronted data of a noisiness or a
03:41:32 7 scatter like this, has any oil company ever come back to you
03:41:35 8 and said, Dr. Gringarten, we found out that the permeability
03:41:40 9 you calculated for us was wrong?

03:41:42 10 A. No.

03:41:42 11 Q. What's the first time in the 30 years you've been doing
03:41:44 12 this, Dr. Gringarten, that someone has ever said to you, what
03:41:48 13 Dr. Gringarten has done is wrong?

03:41:49 14 A. Well, this is the first time with the rebuttal.

03:41:52 15 Q. Let's take a look at -- what are some of the things you do
03:42:03 16 in addition to quantifying an uncertainty range to give
03:42:10 17 yourself assurance that you fitted the data properly to these
03:42:16 18 derivative points?

03:42:16 19 A. Well, we compare -- we do the same type of plot. You
03:42:21 20 know, here we have data, and we have a model that we feed
03:42:27 21 through the data. We verify that the same model can match data
03:42:32 22 in different presentations. So we -- in different plots.

03:42:35 23 So we do a verification process. In fact, the
03:42:40 24 verification process is part of the methodology I established
03:42:45 25 in order to give confidence to both the interpreter and the

03:42:50 1 person that received the interpretation.

03:42:51 2 Q. Let's take a look at D-24666. That's slide 21, please.

03:42:59 3 Is this part of this verification process you
03:43:01 4 described?

03:43:01 5 A. Yes.

03:43:02 6 Q. Tell Judge Barbier what this is and how you used it.

03:43:08 7 A. Well, this is a different way of looking at the data.
03:43:12 8 That's called Horner plot. So these are the same data but
03:43:19 9 presented differently.

03:43:20 10 We have other plots of the same nature. The
03:43:25 11 verification is to make sure that you can reproduce the -- you
03:43:31 12 know, your model, you know, goes through the data. So, you
03:43:34 13 know, you need to be able to reproduce the various plots that you
03:43:38 14 could use and reproduce a derivative as well.

03:43:43 15 Q. Is there another name for a Horner plot?

03:43:46 16 A. It's called a superposition plot.

03:43:48 17 Q. Is it sometimes called a semilog plot?

03:43:52 18 A. A semilog plot is a simplification of the Horner plot, but
03:43:59 19 it's -- that's what we call it in industry.

03:44:01 20 Q. Now, we've look at the derivative plot that you said was
03:44:04 21 the more modern method, and now this Horner plot, or semilog
03:44:10 22 plot. What method did your counterpart expert, the rebuttal
03:44:12 23 expert, Dr. Larsen, use when he tried to analyze permeability?

03:44:17 24 MS. HIMMELHOCH: Objection, Your Honor. This goes to
03:44:19 25 surrebuttal, which you've ruled is improper.

03:44:21 1 MR. BOLES: I just asked him to identify what the
03:44:24 2 method was that Dr. Larsen used, but I can go at this another
03:44:28 3 way.

03:44:28 4 MS. HIMMELHOCH: Dr. Larsen can't testify --

03:44:30 5 THE COURT: Why don't you go ahead. Okay.

03:44:30 6 EXAMINATION BY MR. BOLES:

03:44:33 7 Q. Let me ask you this, Dr. Gringarten. Did you consider
03:44:39 8 using only one method, namely, this semilog/Horner plot method,
03:44:46 9 just using that and not a derivative plot as well?

03:44:49 10 MS. HIMMELHOCH: Your Honor, again, this is an attempt
03:44:50 11 at surrebuttal by disguising the question.

03:44:55 12 MR. BOLES: This is discussed in his expert report,
03:44:57 13 Your Honor. At Page 13 of Dr. Gringarten's expert report, he
03:45:00 14 specifically describes, as he mentioned during his
03:45:04 15 qualifications, how the verification is done through using
03:45:07 16 multiple methods, and that the improvements over the
03:45:13 17 generations of well test analysis have come about from using
03:45:16 18 both this kind of older method and the derivative plot.

03:45:20 19 He specifically discusses that in his report as
03:45:22 20 to why his analysis is more reliable because he uses both
03:45:26 21 methods and uses one to confirm the other. That's on Page 13
03:45:30 22 of his expert report, for example.

03:45:32 23 MS. HIMMELHOCH: Your Honor, he does talk about the
03:45:34 24 history of well test analysis. The way the question was
03:45:36 25 phrased, it implies something about the manner in which

03:45:40 1 Dr. Larsen did his analysis. That was the reason that I
03:45:43 2 objected as surrebuttal.

03:45:44 3 If he phrases the question as what methodologies
03:45:48 4 did he use or what was the evolution of well test analysis, I
03:45:53 5 will withdraw my objection.

03:45:53 6 MR. BOLES: I'll rephrase the question, give it one
03:45:53 7 more try.

03:45:53 8 EXAMINATION BY MR. BOLES:

03:45:55 9 Q. Dr. Gringarten, why did you choose to use both a Horner,
03:45:59 10 or semilog, method and the more advanced derivative plot when
03:46:05 11 you calculated permeability?

03:46:08 12 Let's look at D-24667.

03:46:14 13 A. Okay. As illustrated here, what we have here, Your Honor,
03:46:19 14 we have a log-log plot with derivative, as I've described
03:46:25 15 before. We call that a log-log plot because the pressure and
03:46:28 16 the time are plotted on a log axis.

03:46:32 17 This is the Horner plot, which, you know, is also
03:46:36 18 called a semilog plot or, more generally, superposition. This
03:46:41 19 is a plot that was developed, you know, in the '50s, in '49 to
03:46:46 20 '51. That's essentially the only analysis tool that was
03:46:54 21 available until the late '70s.

03:46:58 22 The problem with this tool is that it is very
03:47:03 23 difficult to know where -- how to calculate the permeability.
03:47:06 24 So you could have different permeabilities and still get a good
03:47:11 25 match on that plot.

03:47:13 1 Q. When you say different permeabilities on that plot, maybe
03:47:18 2 you could make reference to the colors.

03:47:19 3 A. Yes. Essentially we have three possible permeabilities,
03:47:23 4 the red one, the blue one and the black one, I guess -- okay,
03:47:30 5 yes. So I see it better here. It's red, green and then blue.

03:47:37 6 Q. Do those represent different permeabilities?

03:47:39 7 A. They correspond to different permeabilities, and they all
03:47:44 8 match reasonably well the data on that plot.

03:47:46 9 However, if you look at, on this plot on the
03:47:52 10 derivative, you will see that only the green one matches. The
03:47:57 11 red one gives a permeability which is too low. The blue one
03:48:18 12 gives a permeability that is too high.

03:48:22 13 You couldn't see that on this plot, but it is very
03:48:25 14 obvious on the derivative plot. That's the reason why, you
03:48:29 15 know, the methodology requires that, you know, you use the
03:48:36 16 derivative not only to identify the stabilization, but also to
03:48:40 17 verify that the model you've used match the derivative data.

03:48:45 18 Q. Are there any other steps you took besides looking at two
03:48:53 19 different kinds of plots of pressure versus time, any other
03:48:57 20 things you did to confirm or verify the number you were
03:49:04 21 calculating for permeability?

03:49:05 22 A. Yes. I also used deconvolution, which was developed, you
03:49:11 23 know, in the year 2000, 2001 -- what that does is extend the
03:49:17 24 information.

03:49:19 25 In other words, the plot we had before represented

03:49:26 1 the type of buildup, so that's a small portion of the entire
03:49:32 2 test. With deconvolution, then I can get the same kind of
03:49:35 3 derivative but for the duration of the test.

03:49:39 4 So, for instance, to give an example, with Macondo we
03:49:43 5 had a buildup of 19 days, but we had -- and so the derivative I
03:49:49 6 can get from the buildup will have the duration of 19 days,
03:49:55 7 1-9, whereas the spill has a duration of 86 days. With
03:50:05 8 deconvolution, then I can get a derivative that has a duration
03:50:11 9 of 86 plus 19 days. So I can see a lot further in the
03:50:16 10 reservoir than I would otherwise, and that allows me to confirm
03:50:22 11 what I see on the buildup and get additional information.

03:50:26 12 THE COURT: Explain to me again the term
03:50:27 13 "deconvolution."

03:50:29 14 THE WITNESS: Deconvolution is a mathematical process
03:50:32 15 which, let's say, during a test we have the rate going up or
03:50:43 16 going down. Consequently, the pressure goes up or goes down.
03:50:48 17 Deconvolution will recalculate what the pressure would be if
03:50:52 18 the rate had been constant, in a nutshell.

03:50:57 19 Therefore, you know, if I have rates going up or
03:50:59 20 going down, I can only do the interpolation for a period was
03:51:04 21 already constant. That's what we normally get to do. So, for
03:51:09 22 instance, usually we use a buildup, and the buildup has a
03:51:13 23 duration which is small compared to the entire test.

03:51:16 24 With deconvolution, I can convert the entire test
03:51:21 25 into a single throw down, which is equivalent to the buildup,

03:51:25 1 and therefore finds a signature, the complete signature of the
03:51:29 2 system.

03:51:30 3 EXAMINATION BY MR. BOLES:

03:51:32 4 Q. Let's follow up on Judge Barbier's question. We have been
03:51:35 5 focusing here on the MDT tool data from April 12th. Let's take
03:51:41 6 the shut-in of the well on July 15th and the buildup that you
03:51:44 7 analyzed from that shut-in period until the data flow ended
03:51:49 8 with the killing of the well.

03:51:50 9 How did you use deconvolution there to explore the
03:51:56 10 nature of the reservoir and in the way you just described.

03:52:01 11 A. Sorry, could you repeat the question.

03:52:03 12 Q. Specifically with respect to the issue of an aquifer,
03:52:07 13 Dr. Gringarten, does this process of deconvolution which you
03:52:10 14 described allow you to reach a conclusion about whether or not
03:52:11 15 there is an aquifer actively supporting pressure in the
03:52:15 16 Macondo Reservoir?

03:52:16 17 A. Yes, because deconvolution gives what would be the
03:52:20 18 signature of the system for the entire duration of the pressure
03:52:25 19 measurements. So if there is -- so I can see regular flow. As
03:52:35 20 I mentioned before, I could see the lateral boundaries and
03:52:38 21 could see the size of the reservoir because they all give
03:52:42 22 different shapes.

03:52:43 23 If I have an aquifer, then it would give, you know, a
03:52:46 24 shape which is calculated for the aquifer. So here, I have not
03:52:53 25 seen that shape. So the conclusion is that there is no effect

03:52:56 1 of an aquifer, at least during the data that have been
03:53:00 2 measured.

03:53:01 3 Q. Now, let's go back to your actual derivative plot for the
03:53:09 4 Macondo MDT tool test from April 12, 2010. Let's look at,
03:53:13 5 again, D-24665.

03:53:16 6 What did you -- what did you do to quantify the
03:53:24 7 uncertainty around the permeability represented by the red line
03:53:28 8 there?

03:53:30 9 MS. HIMMELHOCH: Your Honor, I'm not so much objecting
03:53:34 10 as requesting a pin cite for this. I can't find this graph in
03:53:37 11 his report, and I'm just trying to make sure I understand what
03:53:40 12 he's asking about.

03:53:42 13 MR. BOLES: Well, it certainly comes from the report.
03:53:44 14 I don't have a pin site at the moment, but my colleagues can be
03:53:47 15 looking for that. I'll go on to --

03:53:50 16 THE COURT: Is this chart from your report?

03:53:53 17 THE WITNESS: Yes.

03:53:54 18 THE COURT: Graph?

03:53:55 19 THE WITNESS: Yes.

03:53:56 20 MS. HIMMELHOCH: Thank you, Your Honor.

03:53:56 21 EXAMINATION BY MR. BOLES:

03:53:58 22 Q. Let's look at how you analyzed that uncertainty with
03:54:01 23 D-24668.

03:54:04 24 What is this, Dr. Gringarten?

03:54:06 25 A. Okay, as I said before, I've looked at the upper bound of

03:54:10 1 the red line and the lower bound of the red line, and that give
03:54:14 2 me the uncertainty of where to calculate the permeability, at
03:54:19 3 what level should the permeability be calculated.

03:54:23 4 I have also taken into account the other
03:54:25 5 uncertainties, the uncertainty on every parameter that goes
03:54:30 6 into the calculation. So that's the uncertainty from the
03:54:33 7 measurement of the pressure, uncertainty on the measurement of
03:54:37 8 the flow rate, uncertainty in the viscosity and so on and so
03:54:41 9 forth, all the parameter that I use to, you know, help me
03:54:44 10 calculate permeability.

03:54:46 11 To evaluate the uncertainty, I've done a
03:54:50 12 probabilistic approach, which is using Monte-Carlo simulation
03:54:55 13 which goes through all the possible values of every parameter
03:55:01 14 and come up with this result here, which is a, you know,
03:55:04 15 bell-shaped curve, which gives me the distribution of the
03:55:10 16 values.

03:55:13 17 And so the most likely value is the median value,
03:55:16 18 which is, in this case, 238 millidarcy. And in the oil
03:55:23 19 industry we call that a P50.

03:55:27 20 And we give two other values. One is a P90, which is
03:55:31 21 here, 170 millidarcy. And P90 means that there is 90 percent
03:55:37 22 chance that the permeability has a higher value than 170.

03:55:42 23 And the other value that is typically given in the
03:55:44 24 oil industry is a P10, which says that the permeability has
03:55:50 25 only 10 percent probability to be greater than this value,

03:55:53 1 which is, in this case, 329 millidarcy.

03:55:57 2 And this representation, P50, P90, P10, is what
03:56:03 3 typically we do, for instance, for reference.

03:56:07 4 THE COURT: It looks like a bell curve.

03:56:10 5 THE WITNESS: That's correct. That's exactly what it
03:56:10 6 is.

03:56:10 7 EXAMINATION BY MR. BOLES:

03:56:11 8 Q. Dr. Gringarten, is there an expert in this case who used
03:56:16 9 the higher number of permeability indicated by your analysis,
03:56:19 10 the P10 value of 329 millidarcies in his analysis?

03:56:26 11 A. Yes. Professor Blunt, who has already testified, he's a
03:56:29 12 BP expert, has used my value of 320 millidarcy.

03:56:35 13 Q. Now, this method that is resulted in this calculation
03:56:40 14 you've just presented of permeability, using the MDT tool, is
03:56:45 15 that used in the industry as a way of calculating permeability?

03:56:49 16 A. Yes.

03:56:50 17 Q. Have you published an article about the increasing use of
03:56:56 18 wireline formation tests for calculating permeability?

03:56:59 19 A. Yes.

03:57:00 20 Q. Let's look at D-24689.

03:57:07 21 Is this your article, Dr. Gringarten, or the first
03:57:09 22 page of it?

03:57:09 23 A. That's correct.

03:57:10 24 The title is *Will Wireline Formation Test* -- which is
03:57:16 25 what we are looking at here -- *Replace Well Tests*?

03:57:19 1 Q. Now, in addition to Schlumberger, who makes the MDT brand
03:57:25 2 of a wireline formation test, are there other service companies
03:57:28 3 in the oil industry, Dr. Gringarten, who make a similar tool
03:57:32 4 and are now marketing it to oil companies as a way of
03:57:35 5 determining permeability?

03:57:36 6 A. Yes. All the service companies, Halliburton, Baker,
03:57:40 7 Weatherford, they all have their version of what we see here.

03:57:45 8 Q. And is the MDT analysis that you've done the only analysis
03:57:49 9 of permeability in this case that uses known flow rate data and
03:57:54 10 known pressure data from before the incident to calculate
03:57:57 11 permeability?

03:57:58 12 A. This is correct.

03:57:58 13 Q. Now, let's look at a summary of the permeability numbers
03:58:02 14 from the various experts in this case, D-23603.

03:58:09 15 Can you summarize, Dr. Gringarten, the numbers used
03:58:12 16 by other experts in the case and the method they've used?

03:58:16 17 MS. HIMMELHOCH: Objection, Your Honor. This
03:58:18 18 demonstrative clearly sets forth surrebuttal since it includes
03:58:21 19 a discussion of Dr. Larsen's work.

03:58:25 20 MR. BOLES: It's very brief, Your Honor, and I think it
03:58:27 21 would provide a helpful overview to the Court.

03:58:30 22 THE COURT: Okay. I sustain the objection.

03:58:30 23 EXAMINATION BY MR. BOLES:

03:58:33 24 Q. Let's move on then.

03:58:40 25 Dr. Gringarten, what would be your opinion of any

03:58:44 1 expert analysis that did not tie its cumulative flow
03:58:49 2 calculation to a known permeability?

03:58:53 3 A. Well, the permeability that I've calculated is
03:59:00 4 permeability of the reservoir, so that's something we know.
03:59:03 5 And in a flow rate, when analyzed with the available pressure
03:59:12 6 measurement during the spill and the subsequent shut-in, have
03:59:17 7 to come up with that permeability. So there is -- the
03:59:24 8 flow rate cannot be independent of the permeability.

03:59:26 9 In other words, this is a triangle that we -- was
03:59:31 10 shown before. You know, if you have the pressure and if you
03:59:37 11 have the flow rate, then you should get the permeability of the
03:59:41 12 reservoir. And so in a flow rate that doesn't give the
03:59:47 13 permeability of the reservoir, it cannot be correct.

03:59:49 14 Q. Now, the United States' expert Dr. Pooladi-Darvish, not a
03:59:54 15 rebuttal expert, uses permeabilities that vary widely from
03:59:59 16 360 millidarcies to 850 millidarcies.

04:00:01 17 What have you said in your expert report,
04:00:04 18 Dr. Gringarten, about that approach by Dr. Pooladi-Darvish?

04:00:09 19 A. Well, Dr. Pooladi-Darvish, you know, is -- in his
04:00:25 20 simulations, is not only changing the permeability, but is also
04:00:48 21 changing at the same time a number of other parameters.

04:00:59 22 And so, therefore, you know, what he -- he's using a
04:01:04 23 range, which is, you know, outside the range of possibilities.
04:01:07 24 And his range should -- you know, when you use -- pressure,
04:01:14 25 should, you know, provide the same permeability as I've

04:01:17 1 obtained.

04:01:18 2 Q. Now, Dr. Gringarten, let's turn, and more quickly now, to
04:01:22 3 the second part of your analysis, which is using the
04:01:27 4 permeability that you just showed us how you derived, and
04:01:30 5 Macondo pressure history to recreate the flow rates and thereby
04:01:35 6 estimate the cumulative flow.

04:01:37 7 Let's go first to D-23601A.

04:01:42 8 Let's review again that triangle of relationships
04:01:47 9 from well test analysis and describe what you're going to do
04:01:51 10 now in the second part of your work.

04:01:52 11 A. Well, now we have -- you know, from the first part, we
04:01:56 12 have the permeability that we have obtained from the MDT.
04:02:00 13 That's from down measurements. And we have pressure
04:02:04 14 measurements, which have been taken during the spill. And we
04:02:08 15 have also pressure measurements, the initial pressure obtained
04:02:12 16 from the MDT on April 12th. And so now I have the pressure and
04:02:16 17 the permeability, and therefore, I can calculate the flow rate.

04:02:19 18 Q. And what is the process that you used, Dr. Gringarten, to
04:02:27 19 take the pressure history in the lower left-hand corner of that
04:02:33 20 triangle and reconstruct the unknown flow rate of Macondo
04:02:38 21 spill? What's the method you used?

04:02:43 22 A. Well, I've used the deconvolution.

04:02:47 23 Q. Now, Doctor -- Judge Barbier asked you about deconvolution
04:02:52 24 earlier, and you gave one application of it in the oil history.
04:02:58 25 Let's look at how you are going to use it here, D-23608A.

04:03:04 1 That's Slide 36.

04:03:11 2 Describe how this analogizes to how you use
04:03:17 3 deconvolution to reconstruct flow rates.

04:03:19 4 MS. HIMMELHOCH: Objection, Your Honor. Relevance.
04:03:21 5 This refers to the use of a mathematical concept in an entirely
04:03:26 6 different industry. Irrelevant to the matter at hand.

04:03:29 7 MR. BOLES: It shows the use of the very same
04:03:32 8 mathematical algorithm, and by analogy, how the fuzzy or
04:03:35 9 unknown data in the left-hand picture can be used to derive a
04:03:40 10 very clear picture, in this case, of the historical Macondo
04:03:42 11 flow rates.

04:03:43 12 I don't believe this was objected to when we
04:03:45 13 submitted this to you some days ago.

04:03:47 14 MS. HIMMELHOCH: I'm objecting now to the testimony,
04:03:49 15 Your Honor. There is a distinction between the use here, which
04:03:52 16 is to sharpen an existing image, and the use that
04:03:56 17 Dr. Gringarten made, which was to create a rate out of
04:03:59 18 information that he claims does not exist. That is the basis
04:04:03 19 for my objection.

04:04:04 20 THE COURT: Is this all in his report?

04:04:06 21 MR. BOLES: This description of the use of
04:04:10 22 deconvolution to take information and extract the maximum value
04:04:16 23 from information that would be unclear without the use of this
04:04:19 24 algorithm is discussed repeatedly in his report, so this is --
04:04:23 25 to help explain that, we're using by analogy.

04:04:26 1 THE COURT: It talks about comparing this to Hubble?

04:04:28 2 MR. BOLES: I don't believe the Hubble telescope is
04:04:32 3 specifically mentioned in his report. This is an illustrative
04:04:35 4 analogy.

04:04:36 5 MS. HIMMELHOCH: It is not discussed, Your Honor.

04:04:37 6 THE COURT: I sustain the objection.

04:04:37 7 EXAMINATION BY MR. BOLES:

04:04:39 8 Q. Let's move on from this image, then.

04:04:41 9 Dr. Gringarten, describe how you used deconvolution
04:04:45 10 to reconstruct the historical flow rates of Macondo. And let's
04:04:51 11 look at Slide 40, D-23620A. Slide 40.

04:05:01 12 A. Okay. The first step is I convert the wellhead pressure
04:05:08 13 to downhole pressure. And I do that because the downhole
04:05:13 14 pressure is more representative of the reservoir than the
04:05:19 15 wellhead pressure. And then I used deconvolution to create
04:05:23 16 rates that are compatible with these downhole pressures.

04:05:29 17 So I start with the rate, let's say, which is
04:05:32 18 constant, and then I apply deconvolution, and that is a rate
04:05:37 19 that I obtain, which is compatible, consistent with the
04:05:41 20 pressure. And so I do several iterations of deconvolution
04:05:47 21 until I get a final rate, and I verify that if I use that rate,
04:05:53 22 then I can reproduce the pressure, which I've started from.

04:05:56 23 Q. Dr. Gringarten, can you describe for Judge Barbier other
04:06:02 24 instances in the oil industry when deconvolution has been used
04:06:08 25 by you or others to correct or recreate rate information that

04:06:14 1 was unknown or unclear?

04:06:15 2 A. Yes. Deconvolution, well, is used -- as I said before,
04:06:21 3 was developed in 2000, 2001. In fact, people have been working
04:06:28 4 for the last 20 years but never came up with a stable
04:06:34 5 algorithm.

04:06:34 6 And so what deconvolution does, it does two things:
04:06:37 7 Number one, it gives a complete signature of the system for the
04:06:42 8 duration of the test, and it allows to correct rates that are
04:06:47 9 erroneous, like which is often the case, or it can allow you to
04:06:54 10 calculate rates that are missing.

04:06:56 11 And to calculate rates that are missing, then you
04:07:09 12 assume a rate, which is arbitrary, and then you do the
04:07:13 13 deconvolution. The deconvolution is going to readjust that
04:07:18 14 rate to the actual pressure measurements. So if you have
04:07:22 15 pressure measurements, then you can correct the rates.

04:07:26 16 Q. And is that process you described with taking either an
04:07:29 17 arbitrary starting rate or other flow rate information and
04:07:35 18 correcting it, either -- by using that deconvolution algorithm,
04:07:40 19 is that something you've done for consulting clients in the oil
04:07:44 20 industry?

04:07:44 21 A. Yes. That's something you do routinely. In the same way
04:07:47 22 as we always use the derivative now for analysis, we always use
04:07:52 23 deconvolution. Deconvolution gives more information and
04:07:56 24 corrects the rate that you start with.

04:07:58 25 Q. Has any other expert in this case used deconvolution to

04:08:03 1 try to reconstruct historical flow rates from Macondo incident
04:08:06 2 from the pressure history?

04:08:07 3 A. No.

04:08:07 4 Q. Now, Dr. Gringarten in this process that you described of
04:08:13 5 reconstructing or correcting a flow rate from the pressure
04:08:19 6 history, can that deconvolution process detect changes in
04:08:26 7 impediments to flow below the pressure measurement gauge?

04:08:29 8 A. No. Because one of the assumptions -- well, the -- what
04:08:37 9 deconvolution does, it looks at the change in pressure from one
04:08:42 10 point in time to the next, and it attributes that change in
04:08:47 11 pressure to a rate. So there is no impediment to flow. This
04:08:53 12 is a process which is separate from what is pure processing of
04:08:58 13 the data.

04:08:59 14 Now, if there is an impediment to flow, deconvolution
04:09:04 15 cannot see that, and it would, therefore, come up with a rate
04:09:08 16 that would be too high compared to what it should be, you know,
04:09:13 17 if there is an impediment to flow.

04:09:16 18 Q. Now, are you in this case, Dr. Gringarten, offering any
04:09:20 19 opinions on erosion of impediments to flow in the Macondo well
04:09:25 20 over time?

04:09:26 21 A. No, I'm not.

04:09:27 22 Q. Why is that?

04:09:28 23 A. Because my focus -- well, number one -- two reasons.
04:09:33 24 Number one, my focus was on the permeability because that's
04:09:37 25 what I need to calibrate the rate that I calculate from the

04:09:43 1 deconvolution. And the only impediment or skin that I can
04:09:51 2 calculate with confidence is the one that I can calculate from
04:09:54 3 the buildup, which is, you know, what we have here at the end.

04:10:00 4 Q. And when does that begin?

04:10:02 5 A. That begins on July 15th.

04:10:06 6 Q. Now, let's look at a road map, I believe this is Slide 46,
04:10:13 7 of your -- of your analysis. And this is all in your report,
04:10:17 8 so we're not going to go into it in detail.

04:10:20 9 But you've just spoken to us about -- let me get my
04:10:23 10 own pointer here -- taking the pressure history and using the
04:10:28 11 process of deconvolution to extract information to reconstruct
04:10:34 12 the rate history. And we're going to now ask you to describe
04:10:40 13 what you do once you get that relative rate history.

04:10:44 14 And, first of all, what do you mean by *relative rate*
04:10:47 15 *history*?

04:10:48 16 A. The -- what I can calculate from deconvolution is, you
04:10:52 17 know, the successive rates relative to one another, so I cannot
04:11:00 18 calculate an absolute value. I calculate the Delta Q, the
04:11:06 19 change in rate that would create the change in pressure.

04:11:11 20 In normal well tests, there are, you know, unknown --
04:11:16 21 there are errors in the rates, but usually we have one rate or
04:11:21 22 a few rates that we trust. And therefore, we are going to
04:11:24 23 calibrate the relative rate history on those rates.

04:11:28 24 Here, we do not have a rate that we can, you know,
04:11:32 25 rely upon, so what we do is we -- I take this rate history,

04:11:39 1 relative rate history, and the pressure history and I do a
04:11:44 2 well test analysis. The well test analysis gives me
04:11:48 3 permeability, and then I compare that permeability to the
04:11:53 4 permeability I know for the reservoir, which I've obtained from
04:11:58 5 MDT analysis.

04:11:59 6 And if they are different, then I address -- you
04:12:04 7 know, multiply the relative rate by a factor which is such
04:12:10 8 that -- which is a ratio of what I obtain here in -- you know,
04:12:14 9 in the analysis with that rate with the MDT permeability, so
04:12:22 10 that I can correct that rate and obtain the same permeability
04:12:25 11 from the analysis that I did from MDT.

04:12:28 12 Q. Now, we'll look at the -- how you do that in a minute, but
04:12:32 13 let me just ask you in this summary road map of your work, the
04:12:35 14 two blue boxes with the gears next to them, what do they
04:12:39 15 represent?

04:12:39 16 A. They represent two steps in the process. One is the
04:12:49 17 processing of the data, deconvolution. And the other one is
04:12:53 18 the analysis of the data.

04:12:56 19 And so what this does, it makes the rate history
04:13:01 20 consistent with pressure. And what this does is, you know,
04:13:06 21 with this final result on the rate history, is to make the rate
04:13:10 22 history consistent with the reservoir permeability.

04:13:12 23 Q. Now, do you use software for these two steps showing in
04:13:17 24 the blue boxes with the gears?

04:13:18 25 A. Yes.

04:13:20 1 Q. Is the deconvolution software separate from your well test
04:13:25 2 analysis software?

04:13:27 3 A. In my case, yes. Some of the commercial software have the
04:13:31 4 two integrated.

04:13:32 5 Q. Now, we're about to describe this penultimate step of the
04:13:40 6 well test analysis. Does that analysis take as an input the
04:13:44 7 relative rate histories from the deconvolution?

04:13:47 8 A. Yes.

04:13:47 9 Q. And do -- are those the rate histories that you described
04:13:52 10 earlier that cannot convey information about historical changes
04:14:00 11 and impediments to flow in the wellbore?

04:14:03 12 A. No.

04:14:03 13 Q. I may have put a double negative in my question.

04:14:07 14 Do the rate histories that deconvolution delivers to
04:14:12 15 the well test analysis software have any information about the
04:14:17 16 changes in impediments of flow over the history of the
04:14:21 17 incident?

04:14:21 18 A. No.

04:14:21 19 Q. Now, let's look at what you do with a well test analysis
04:14:27 20 and let's look at a couple of outputs from that second
04:14:31 21 software, the well test analysis software, D-24696, Slide 44.

04:14:38 22 What is this step in your analysis, Dr. Gringarten?

04:14:42 23 A. Well, this is a summary in terms of graphs of the
04:14:46 24 analysis, and there are two parts here. If we look at the
04:14:51 25 graph on the left-hand side, the first two -- you know, the

04:14:56 1 starting point is this graph, which is a normal graph, which is
04:15:04 2 pressure and derivatives.

04:15:07 3 Q. You're referring to the upper left-hand graph.

04:15:07 4 A. Correct.

04:15:08 5 Q. What is that called?

04:15:09 6 A. This is called the log-log diagnostic plot. That's where
04:15:12 7 we select the various regime and, in particular where we're
04:15:16 8 going to calculate permeability.

04:15:17 9 Q. Can you relate that to something you've already talked
04:15:20 10 about in the permeability part of your work? Is this the
04:15:25 11 derivative plot?

04:15:25 12 A. Yes, this the derivative. I thought I mentioned it, yes.

04:15:29 13 Okay. And here, you know, we have a flat part.
04:15:34 14 That's where we calculate the permeability. And we verify that
04:15:37 15 we have, on the Horner plot, a straight line from which we
04:15:42 16 calculate permeability, so this is a verification.

04:15:45 17 And then we generate a model, and we make sure that
04:15:50 18 the model fits, you know, match all the data. So here we match
04:15:55 19 the pressure. We match the derivative, and we match, you know,
04:16:00 20 the Horner plot as well.

04:16:02 21 And the last plot here is we take the model and then
04:16:10 22 we compare with the pressure that has been measured during the
04:16:16 23 spill, and any mismatch between the pressure and the model is
04:16:22 24 attributed to the skin effect, which is represented here.

04:16:25 25 Q. Are these graphs we see, are these standard displays built

04:16:31 1 into the software?

04:16:31 2 A. Yes.

04:16:32 3 Q. Let's look at the -- in the lower left-hand side, what is
04:16:38 4 it that you -- did you -- how did you use the skin versus time
04:16:41 5 plot in the lower left-hand panel of this software dashboard?

04:16:46 6 A. Well, we verify that we end up with results that are
04:16:53 7 reasonable, can be explained, especially that there is no value
04:16:59 8 which is unphysical. For instance, if we would come up with a
04:17:04 9 skin less than minus 4, that doesn't exist, so that means
04:17:08 10 something is wrong in the analysis.

04:17:09 11 Q. What about the right-hand side of that graph? Was that
04:17:13 12 something that you used?

04:17:13 13 A. This one here?

04:17:16 14 Q. Yes. The right-hand end of the --

04:17:18 15 A. This is the skin obtained from the buildup. And this is
04:17:24 16 calculated by -- you know, from the analysis. This one here is
04:17:29 17 simply an expression of the mismatch between the data and the
04:17:34 18 model.

04:17:34 19 Q. Now, in the flat part of that skin versus time graph, if
04:17:39 20 we were to be able to see the timeline, it reflects May 8th to
04:17:43 21 July 15th, does that tell you anything about what is physically
04:17:45 22 happening in the wellbore in terms of impediments to flow?

04:17:49 23 A. No. Not really. Because this is obtained from the
04:17:53 24 mismatch. So that's -- you know, the value that we need -- I
04:18:03 25 have indicated that in my report, is what you need to -- for

04:18:06 1 the model to match the data.

04:18:09 2 Q. Now, let's look at the result of this well test modeling
04:18:14 3 and what you do with it with respect to the relative flow rates
04:18:19 4 that you derived from deconvolution.

04:18:21 5 Let's go to Slide 47, D-24222.

04:18:26 6 What are we looking at here, Dr. Gringarten?

04:18:29 7 MS. HIMMELHOCH: Objection, Your Honor. This
04:18:32 8 mischaracterizes Dr. Dykhuizen's flow rate analysis.

04:18:36 9 Also, this graph, as it appears here, does not
04:18:40 10 appear in Dr. Gringarten's report.

04:18:43 11 MR. BOLES: The rate curves do, and to aid the Court to
04:18:48 12 show how this relates to --

04:18:48 13 THE COURT: I'll overrule the objection. And if you
04:18:52 14 want to cross-examine him on the accuracy of it, you can do
04:18:55 15 that.

04:18:55 16 MS. HIMMELHOCH: We'll do so, Your Honor.

04:18:57 17 THE COURT: Go ahead.

04:18:59 18 What was your question for the witness?

04:18:59 19 EXAMINATION BY MR. BOLES:

04:19:03 20 Q. Describe for Judge Barbier this result of your well test
04:19:08 21 analysis using your deconvolved flow rates.

04:19:12 22 A. Okay. I have considered different case in converting from
04:19:19 23 wellhead pressure to bottomhole pressure. Wellhead pressure is
04:19:24 24 the PTB pressure and the capping stack pressure during the
04:19:29 25 shut-in.

04:19:29 1 Then I considered several flow paths, in fact, two
04:19:35 2 flow paths in the well, and the calculation has been made with
04:19:39 3 the multiphase flow simulator by Dr. Johnson, who was a BP
04:19:45 4 expert, and I end up with the blue curve, which correspond to
04:19:55 5 my permeability of 238 millidarcies.

04:19:59 6 So this is the flow rate for one of the case, which
04:20:03 7 is the most likely case, corresponding to the P50 permeability
04:20:09 8 obtained from the MDT.

04:20:10 9 Q. When you say *most likely case*, just to clarify, that
04:20:13 10 refers to what, Dr. Gringarten?

04:20:14 11 A. Most likely means that I am consistent with the range of
04:20:23 12 flow that were given between May 13th and May 20th by
04:20:29 13 Dr. Zaldivar from his fluid flow calculation.

04:20:35 14 And here I -- you know, I used the range of flow
04:20:43 15 before shut-in that were given by another BP expert, and I'm
04:20:50 16 slightly below the value that was given by that expert.

04:20:55 17 Another flow possibility, you know, with the same
04:21:00 18 configuration is this flow rate in green, which, you know,
04:21:05 19 matched around 45,000 barrels at the time of shut-in and still
04:21:10 20 goes through the range given by Dr. Zaldivar. This does not
04:21:19 21 correspond to the P50 probability of 238. It requires a
04:21:25 22 permeability slightly higher, which is 281, which would
04:21:30 23 correspond to P35.

04:21:31 24 Q. Was that green permeability that you scaled the rate to in
04:21:37 25 that most likely case, was that one of the permeabilities

04:21:40 1 within your range of possibilities that you analyzed?

04:21:42 2 A. Yes. It's between the P50 and the P10. It's around P35.

04:21:49 3 Q. Let's look at the cumulative flows that you calculate from
04:21:54 4 these two possible rate histories, including the most likely
04:21:59 5 rate history with the P50 permeability.

04:22:02 6 Let's go to Slide 48, D-23622.

04:22:07 7 Now, relate that to the two curves we just looked at,
04:22:11 8 Dr. Gringarten.

04:22:12 9 A. This number here, 2.5 million stock-tank barrel
04:22:19 10 corresponds to the permeability of P50, so that was the blue
04:22:22 11 curve on the previous slide.

04:22:25 12 This corresponds to a rate of 45,000
04:22:31 13 stock-tank barrel per day at the time of shut-in, and so that
04:22:35 14 correspond to the green curve.

04:22:37 15 And so this one gives me cumulative discharge of
04:22:43 16 2.5 million stock-tank barrel. This gives a discharge of
04:22:49 17 3 million stock-tank barrel.

04:22:51 18 Q. And let's go to Slide 49, D-24223.

04:22:56 19 Which is other cases that you looked at that you
04:22:59 20 called Option 2 for a different starting flow rate in your
04:23:04 21 pressure translation, and two different configurations of the
04:23:08 22 wellbore.

04:23:09 23 Describe what you determined with respect to
04:23:13 24 cumulative flow using your P50 permeability and with a higher
04:23:17 25 permeability that would scale those flow rates to an ending

04:23:20 1 flow rate of 45,000 stock-tank barrels per day.

04:23:23 2 A. Well, these are two options, as I've indicated. I've used
04:23:29 3 a range of downhole pressure to cover, you know, the range of
04:23:35 4 uncertainty. And so these are two other cases that give me --
04:23:40 5 for the P50, which means they correspond to the
04:23:47 6 238 millidarcies. And this one, you know, that gives a range
04:23:49 7 of 2.4 to 3 million stock-tank barrel.

04:23:52 8 And, you know -- you know, the case, but they don't
04:23:57 9 give 45,000 stock-tank barrel per day at the time of shut-in,
04:24:02 10 so to get 45,000 stock-tank barrel at the time of shut-in, then
04:24:07 11 I need higher permeability and this gives me 3.3 million
04:24:12 12 stock-tank barrel in terms of total discharge.

04:24:15 13 Q. Dr. Gringarten, I would like to end by just having you
04:24:18 14 describe what -- for Judge Barbier your -- you read Dr. Blunt's
04:24:26 15 expert report in this case?

04:24:28 16 A. Yes.

04:24:28 17 Q. And what is your opinion of his work?

04:24:30 18 MS. HIMMELHOCH: Objection, Your Honor. They did not
04:24:32 19 provide an analysis of Dr. Blunt's report and his opinion of
04:24:36 20 Dr. Blunt's report in Dr. Gringarten's report.

04:24:39 21 MR. BOLES: Well, he does say that he approves of
04:24:42 22 Dr. Blunt's work. And counsel for the United States has
04:24:44 23 repeatedly asked their experts to compare methods used by their
04:24:49 24 various colleagues on the same side of the case in order to
04:24:52 25 help illustrate to the Court the advantages and disadvantage of

04:24:55 1 different methods, so I think it would be helpful to the Court.

04:24:58 2 MS. HIMMELHOCH: Your Honor, he does indicate that he
04:24:59 3 reviewed Dr. Blunt's conversion of capping stack pressures,
04:25:02 4 which is a direct input into his analysis. But he does not
04:25:05 5 provide a general endorsement or analysis of Dr. Blunt's
04:25:10 6 opinions.

04:25:11 7 THE COURT: Well, I don't remember with the other
04:25:16 8 witnesses whether the issue came up. Again, is this something
04:25:20 9 that's in his report or not?

04:25:22 10 MR. BOLES: Just to go to the one point you mentioned,
04:25:24 11 Your Honor, that Dr. Kelkar was the one that they asked to
04:25:31 12 elaborate on and explain the advantages and disadvantages of
04:25:35 13 his material balance analysis compared to the analysis done by
04:25:38 14 other United States experts, which wasn't in his report.

04:25:41 15 MS. HIMMELHOCH: If they will allow the same of our
04:25:44 16 rebuttal witnesses, I will withdraw my objection.

04:25:46 17 MR. BOLES: In answer to your other question,
04:25:48 18 Your Honor, the reference to Dr. Gringarten's report and his
04:25:52 19 discussion of Dr. Blunt is on page 35 of his report, where he
04:25:56 20 says that, "Dr. Blunt used a different methodology to analyze
04:26:01 21 the Macondo Reservoir and the cumulative flow. I've reviewed
04:26:04 22 his report and approve his analysis."

04:26:06 23 So I would like to ask him to explain that.

04:26:06 24 THE COURT: All right.

04:26:10 25 MS. HIMMELHOCH: I apologize for the mistake,

04:26:11 1 Your Honor.

04:26:12 2 THE COURT: I'll let him. Go ahead. Overrule the
04:26:16 3 objection.

04:26:16 4 BY MR. BOLES:

04:26:17 5 Q. So, Dr. Gringarten, does your analysis directly use as an
04:26:23 6 input rock compressibility?

04:26:28 7 A. Not for the purpose of the result that I give. In other
04:26:34 8 words, the compressibility has no impact on my permeability.
04:26:40 9 It would have an impact on the size of the reservoir that I
04:26:43 10 calculate because as the start of the analysis I calculate a
04:26:45 11 number of things. I calculate the size of reservoir, I
04:26:49 12 calculate the average reservoir pressure and so forth; but, for
04:26:53 13 answering the question that I was asked to answer, I only used
04:26:58 14 permeability, and the permeability is independent of
04:27:01 15 compressibility in my technique.

04:27:04 16 Q. In terms of the relative uncertainties or advantages and
04:27:08 17 disadvantages of your analysis that we've just reviewed using
04:27:13 18 well test analysis and deconvolution in particular to
04:27:15 19 reconstruct the flow rates during the incident, and Dr. Blunt's
04:27:20 20 material balance analysis, which doesn't require that, can you
04:27:23 21 describe for Judge Barbier your opinion as to the relative
04:27:26 22 advantages and disadvantages and uncertainties?

04:27:30 23 A. Well, these are two different approach to trying to come
04:27:35 24 to the same result. This is not unusual in the oil business
04:27:39 25 because we are dealing with uncertainty. So we try to have

04:27:43 1 redundancy and try to arrive at the same result by different --
04:27:47 2 the same result by different methods. You know, you don't get
04:27:52 3 the same result, but you get, you know, a range, and the range
04:27:55 4 hopefully overlaps.

04:27:56 5 In terms of my technique, of course, you know, I rely
04:28:02 6 on the pressure during the spill. The advantage of method of
04:28:11 7 the material balance used by Dr. Blunt is that he doesn't have
04:28:15 8 to do that. You know, he has data before the spill, and then
04:28:19 9 he has data in the shut-in after the spill.

04:28:22 10 So he has, you know, only three variables.
04:28:26 11 Therefore, I must admit that he has less uncertainty that I do
04:28:32 12 to deal with. So, you know, if we have to select one, maybe
04:28:39 13 his is more -- you know, is less uncertainty. Also, my results
04:28:44 14 back up his results. I stand by my results, obviously.

04:28:51 15 Q. Dr. Gringarten, in your -- in those cumulative flow
04:28:55 16 numbers we just saw, what method did you use to convert from
04:28:58 17 the reservoir volume to the surface volume, or
04:29:02 18 stock-tank barrels?

04:29:04 19 A. I used the formation volume factor that was provided in
04:29:13 20 his table by Dr. Curtis Whitson.

04:29:18 21 Q. What method was used to come up with that formation volume
04:29:21 22 factor?

04:29:22 23 A. The single-stage flush.

04:29:25 24 Q. I just want to --

04:29:27 25 MR. BOLES: I'm almost done, Your Honor. I have a

04:29:27 1 couple of points that I forgot.

04:29:31 2 I don't think I mentioned for the record that
04:29:33 3 when I was -- when we were looking at the standard dashboard of
04:29:38 4 graphs from the well test interpretation software, that was
04:29:44 5 demonstrative D-24697.

04:29:44 6 BY MR. BOLES:

04:29:48 7 Q. I didn't really plan it this way, Dr. Gringarten, but I
04:29:52 8 actually forgot to ask you about your awards and recognitions
04:29:54 9 in the field, so let's end there.

04:29:56 10 Let's go to slide 6, D-23618.

04:30:01 11 I'm not going to go through all of those, but,
04:30:05 12 Dr. Gringarten, that second bullet point, that you've been
04:30:09 13 recognized by the SPE as one of the legends of the petroleum
04:30:14 14 engineering industry this past year.

04:30:15 15 First of all, what is the SPE?

04:30:19 16 A. The SPE is the Society of Petroleum Engineers. It's a
04:30:22 17 professional society with about 110,000 members around the
04:30:26 18 world.

04:30:26 19 Q. Of those 110,000 members present and many more past, how
04:30:31 20 many of them have received this designation as one of the
04:30:35 21 legends in the petroleum industry?

04:30:37 22 A. I think, less than ten.

04:30:38 23 Q. What does that signify?

04:30:41 24 A. Well, this is to recognize people that have -- for their
04:30:49 25 entire contribution to the industry, and to just acknowledge

04:30:56 1 the legacy of their contribution.

04:31:00 2 MR. BOLES: Thanks, Dr. Gringarten.

04:31:30 3 MS. HIMMELHOCH: Good afternoon, Your Honor.

04:31:31 4 Sara Himmelhoch on behalf of the United States. May I proceed?

04:31:34 5 THE COURT: Yes.

04:31:16 6 CROSS-EXAMINATION BY MS. HIMMELHOCH:

04:31:34 7 Q. Good afternoon, Dr. Gringarten. It's good to see you
04:31:38 8 again.

04:31:38 9 A. Good afternoon.

04:31:39 10 Q. I want to begin by talking a little bit about that last
04:31:41 11 half of your testimony which was how you calculated your
04:31:44 12 cumulative volume of oil released.

04:31:46 13 Now, you started that calculation by assuming
04:31:49 14 flow rates; isn't that correct?

04:31:51 15 A. That's correct.

04:31:51 16 Q. Then you used deconvolution to match those assumed
04:31:55 17 flow rates to the pressures measured at the PT-B gauge, which
04:31:59 18 is on BOP, correct?

04:32:00 19 A. Yes. That's the starting point, yes.

04:32:02 20 Q. Then from there, Dr. Johnson took your flow rate history
04:32:06 21 and converted it -- converted the PT-B pressures to
04:32:10 22 bottomhole pressures, correct?

04:32:11 23 A. Yes.

04:32:11 24 Q. From that point forward, any flow rate history matching
04:32:15 25 you did was to those converted bottomhole pressures; isn't that

04:32:19 1 correct?

04:32:19 2 A. That's correct.

04:32:19 3 Q. In other words, from that point on, you took as bottom --
04:32:24 4 as ground truth the bottomhole pressures that were calculated
04:32:27 5 from that assumed flow rate; isn't that correct?

04:32:29 6 A. What I have obtained is a range of downhole pressure. The
04:32:37 7 purpose of getting a range is to take into account the
04:32:39 8 uncertainty, you know, in the data and in the conversion.

04:32:43 9 So I tried to cover a range that would seem
04:32:46 10 reasonable, and therefore would give me, you know, a reasonable
04:32:49 11 range of, you know, total discharge.

04:32:53 12 Q. I think my question was not clear, so let me try it again.
04:32:58 13 You took that converted downhole bottomhole pressure range as
04:33:02 14 your ground truth against which for future flow rate matching
04:33:07 15 you used that bottomhole pressure, correct?

04:33:09 16 A. Yes.

04:33:09 17 Q. That bottomhole pressure was calculated from your assumed
04:33:13 18 flow rate, correct?

04:33:13 19 A. Yes.

04:33:17 20 Q. Okay. Let's move on to another aspect of your
04:33:22 21 deconvolution procedure. You applied your methodology to these
04:33:26 22 two different options, which we'll call Option 1 and Option 2,
04:33:29 23 as you did in your report, correct?

04:33:31 24 A. That's correct.

04:33:31 25 Q. Option 1 assumed a consistent 45,000 stock-tank barrels

04:33:36 1 per day during this spill; isn't that correct?

04:33:39 2 A. Yeah, as a starting point, yes.

04:33:41 3 Q. Option 2 assumed 30,000 a day until May 31st, and then
04:33:46 4 45,000 thereafter, correct?

04:33:47 5 A. That's correct.

04:33:47 6 Q. Now, using those two different starting points, you got
04:33:51 7 two different answers, didn't you?

04:33:54 8 A. Yes. Well, there is a step in between, which is, you
04:33:57 9 know, I take these two starting values, and I make them
04:34:03 10 consistent with the pressure, the wellhead pressure, with
04:34:08 11 deconvolution.

04:34:08 12 So I end up with two rates of distribution that are
04:34:14 13 simply, you know, a multiplication of one -- you know, they are
04:34:21 14 off by a multiplication factor.

04:34:24 15 Q. Right, but matching the same pressures with different --

04:34:26 16 A. That's right. Therefore, they are the same shape.

04:34:28 17 Q. They have the same shape, but using the same pressures to
04:34:33 18 match, you got from your Option 1 a cumulative flow of 2.49,
04:34:40 19 and from Option 2 a cumulative 3.0 million stock-tank barrels;
04:34:40 20 isn't that correct?

04:34:46 21 A. That's correct.

04:34:46 22 Q. So using different starting points, you wound up with
04:34:49 23 different cumulative volumes of oil released?

04:34:52 24 A. Yes, and that's called a range.

04:34:53 25 Q. Right. But both of those curves were supposed to be

04:34:56 1 matched to the same set of pressure data; isn't that correct?

04:34:59 2 A. I'm not sure what you mean by that.

04:35:00 3 Q. In order to complete your deconvolution process, you took
04:35:04 4 your assumed flow rate and adjusted -- deconvolved them against
04:35:08 5 the bottomhole pressures that Dr. Johnson calculated?

04:35:11 6 A. Yes, once I got the bottomhole pressures, yes.

04:35:14 7 Q. You used the same bottomhole pressures to deconvolve your
04:35:19 8 Option 1 as you did to deconvolve your Option 2?

04:35:22 9 A. I'm confused.

04:35:26 10 Q. You deconvolved a flow rate history derived from Option 1,
04:35:32 11 correct?

04:35:32 12 A. Yes.

04:35:33 13 Q. You deconvolved a flow rate history derived from Option 2?

04:35:37 14 A. Yeah, before conversion I used --

04:35:40 15 Q. Both before and after. Didn't you deconvolve them twice?

04:35:44 16 A. Yes.

04:35:45 17 Q. At the top, and then you got a bottomhole pressure?

04:35:47 18 A. The first deconvolution was to get the rate which
04:35:51 19 Dr. Johnson could use in his multiphase simulator. Those rates
04:35:58 20 differ by a multiplication factor.

04:36:01 21 So the idea here is to have a range of
04:36:04 22 bottomhole pressures that would represent the possible range of
04:36:11 23 what did happen because we didn't measure.

04:36:13 24 So once I have the bottomhole pressure, you know,
04:36:16 25 then I start again. You know, I, as you say, consider his

04:36:21 1 bottomhole pressure as representative. Then I calculate the
04:36:26 2 rates by deconvolution from these bottomhole pressures.

04:36:29 3 Q. Now, using the two different flow rates but the same
04:36:34 4 pressure data, you arrived at two different flow rate
04:36:37 5 histories, as you've just said, correct?

04:36:40 6 A. Not from the same pressure data. You know, once I have
04:36:45 7 pressure -- that's something, you know, I'm missing here. Once
04:36:47 8 I have -- you know, I have four bottomhole pressures.

04:36:51 9 Q. Yes.

04:36:54 10 A. So for each bottomhole pressure, I'm going to recalculate
04:36:58 11 a rate which is consistent with that bottomhole pressure.

04:37:03 12 So there are -- you know, so for each pressure, I do
04:37:05 13 the conversion. For each bottomhole pressure, I get a rate
04:37:10 14 which is consistent with that bottomhole pressure.

04:37:12 15 Q. Now, the deconvolution you do at the bottomhole, after
04:37:18 16 you've converted the pressures down at the bottomhole, what
04:37:21 17 you're attempting to do in that deconvolution is to minimize
04:37:24 18 the difference between the measured value and the calculated
04:37:27 19 value; is that correct?

04:37:34 20 In your deconvolution process, you're trying to the
04:37:39 21 minimize the difference between your measured pressure --

04:37:39 22 A. The verification -- you know, you do deconvolution.

04:37:39 23 Q. Yes.

04:37:43 24 A. That for a given bottomhole pressure, you know, one case.
04:37:48 25 You get the rate history. You verify that the deconvolution is

04:37:56 1 consistent by recalculating the rate with that pressure -- you
04:38:01 2 know, with that rate that you -- and then comparing with the
04:38:04 3 pressure you have started from.

04:38:05 4 Q. Correct.

04:38:07 5 A. So you do a number of iterations until you get, you know,
04:38:12 6 almost perfect match.

04:38:13 7 Q. When you did your deconvolution at the bottomhole against
04:38:17 8 your bottomhole pressures, you obtained a different flow rate
04:38:21 9 profile than you had when you did the deconvolution at the top
04:38:24 10 of the well; isn't that correct?

04:38:25 11 A. That's correct because these are two different things.
04:38:28 12 One is for getting downhole. The other is when downhole, you
04:38:34 13 know, to what would be downhole.

04:38:36 14 You know, the purpose, again, is to have a range of
04:38:39 15 pressure downhole that would cover a possibility, and then you
04:38:43 16 start from there.

04:38:43 17 Q. Once you've deconvolved it downhole, those flow rates are
04:38:48 18 more accurate in your view; isn't that correct?

04:38:50 19 A. There are -- those rates represent -- you know, what --
04:38:57 20 these rates are consistent with downhole pressure.

04:39:01 21 Q. Yet you didn't go back and readjust your downhole pressure
04:39:06 22 based on these new flow rates, did you?

04:39:08 23 A. Because there is no point. I mean, they would never
04:39:11 24 converge.

04:39:11 25 You know, if you look at the well, you know, normally

04:39:14 1 in oil wells, we measure systematically is wellhead pressure,
04:39:19 2 and, you know, in normal well tests, we have also downhole
04:39:25 3 pressure.

04:39:25 4 The wellhead pressure and downhole pressure are
04:39:27 5 different. For instance, here we have single phase at the
04:39:29 6 bottom of the well, we have two phase at the top of the well.
04:39:32 7 The pressure profiles are completely different, so there is no
04:39:36 8 way that by this over here you're going to have the same
04:39:38 9 deconvolution by deconvoluting the wellhead pressure and
04:39:43 10 deconvoluting the bottomhole pressure. So, you know, there is
04:39:46 11 no point in trying to do it because you'll never converge by
04:39:50 12 definition.

04:39:50 13 Q. Do you recall testifying in your deposition that the
04:39:53 14 reason you did not go back and reiterate is because the value
04:39:56 15 would have landed in between the two flow rate profiles?

04:39:58 16 A. Yes, and --

04:40:02 17 Q. That's the answer you gave at your deposition, correct?

04:40:05 18 A. No. Well, if I recall, you were talking about why didn't
04:40:09 19 I use a higher -- you know, why didn't I start with 60 -- 50 or
04:40:17 20 60,000 barrels at the very beginning of the process.

04:40:20 21 Q. I'll move on and come back to this when I find my
04:40:33 22 deposition cite.

04:40:34 23 Now, you agree there is only one set of PT-B
04:40:37 24 pressures, correct?

04:40:38 25 A. Yes.

04:40:38 1 Q. You deconvolved two assumed rates to those PT-B pressures
04:40:46 2 and got two different rates; isn't that correct?

04:40:47 3 A. Yes, by definition. You know, as I have explained in the
04:40:54 4 direct part of my testimony -- may I -- what you get from
04:41:01 5 deconvolution is the relative rate.

04:41:04 6 So if I start with a higher rate, then I'm going to
04:41:07 7 have, you know, a higher deconvolved rate. So, of course, in
04:41:13 8 the process which I did downhole, I had just the relative rate
04:41:18 9 to the permeability. You know, if I were to do that with the
04:41:22 10 deconvolution at the wellhead, I would get only one rate
04:41:26 11 history because it would be adjusted to the permeability from
04:41:31 12 MDT, but that's not what I'm trying to do here. I'm trying to
04:41:34 13 have a range of downhole pressure.

04:41:37 14 So I start with, you know, the range of the one --
04:41:40 15 you know, a rate history which allows me to do that.

04:41:45 16 Q. Can I just -- you've given your explanation, but let me
04:41:50 17 just make sure it's clear on the record.

04:41:52 18 When you deconvolved two assumed rates to the same
04:41:58 19 PT-B pressures, you got two different flow rates, correct?

04:42:01 20 A. Of course. They have the same shape. That's very
04:42:04 21 important. They are shifted, you know, by the ratio of the
04:42:09 22 cumulative production that these two rates represent.

04:42:12 23 Q. Let's go to TREX-011696R1 -- I'm sorry, 37.1.US, please.
04:42:29 24 This is your deconvolved rates at top hole, correct?

04:42:37 25 A. That's correct.

04:42:37 1 Q. The shape of these curves is the same, correct?

04:42:38 2 A. That's correct.

04:42:39 3 Q. But they are different values; isn't that correct?

04:42:41 4 A. Yes.

04:42:41 5 Q. Those were deconvolved using the same pressure, correct?

04:42:46 6 A. Yes, absolutely. That's the reason why they are the same
04:42:49 7 shape.

04:42:49 8 Q. Now, let me just confirm another fact that wasn't talked
04:42:53 9 about in your direct but I think is clear. You did not use any
04:42:56 10 of the information regarding the amount of fluid that was
04:42:59 11 collected or the amount of oil that was collected after the
04:43:02 12 insertion of the Riser Insertion Tube Tool and the other
04:43:06 13 collections method that were used?

04:43:07 14 A. No.

04:43:08 15 Q. You didn't use them, in fact, because you said that the
04:43:10 16 collection rates were a small fraction of what was released;
04:43:14 17 isn't that correct?

04:43:14 18 A. That's what I said, yes.

04:43:16 19 Q. In your opinion, therefore, 810,000 barrels was a small
04:43:23 20 fraction of what was released; isn't that correct?

04:43:26 21 A. Yes.

04:43:26 22 Q. Okay. Let's move on to another point that has been made
04:43:34 23 by your counsel in questioning of the government's witnesses,
04:43:38 24 and that is this question of a day-by-day calculation.

04:43:41 25 Let's call up TREX-011696R.0053.1.US.

04:43:51 1 This is a graph from your report, is it not, sir?

04:43:53 2 A. Yes.

04:43:55 3 Q. This shows that in your analysis what you do is you come
04:44:00 4 up with a daily flow rate, and then you sum that to come up
04:44:04 5 with your cumulative volume of oil released, correct?

04:44:06 6 A. Yes.

04:44:07 7 Q. In the words of Mr. Brock -- I almost gave you doctorate,
04:44:11 8 Mr. Brock -- in the words of Mr. Brock, therefore your analysis
04:44:14 9 is a day-by-day calculation, isn't it?

04:44:16 10 A. Yes.

04:44:17 11 Q. Okay. Let's go on to talk a little bit about the
04:44:22 12 pressures that you used. I want to focus for this time period
04:44:27 13 on the period before May 8th.

04:44:29 14 The calculated rates that you use are dependent on
04:44:34 15 the pressure measurements that you have, correct?

04:44:36 16 A. Yes.

04:44:37 17 Q. You have agreed, have you not, that the PT-B pressure data
04:44:41 18 that began on May 8th can be used reliably as part of an
04:44:46 19 estimate of the cumulative volume of oil released, correct?

04:44:51 20 A. Yes, I think I've said that, you know, I calculated the
04:44:54 21 rate from these pressure measurements, and then I summed them
04:44:58 22 up.

04:44:58 23 Q. You specifically agreed with me at your deposition that
04:45:01 24 these pressures can be used reliably as part of an estimate of
04:45:06 25 the cumulative volume of oil release, didn't you?

04:45:09 1

A. Yes.

04:45:09 2

Q. But prior to May 8th, we don't have the PT-B pressures, correct?

04:45:13 3

04:45:13 4

A. Well, we have one pressure at Time Zero, you know, when the -- which is the pressure converted to wellhead that we obtained from the MDT on April 12th. So we have one point.

04:45:18 5

04:45:24 6

04:45:28 7

Q. Please forgive me, but I asked a much more specific question. Prior to May 8th, we don't have any PT-B

04:45:31 8

04:45:35 9

measurements; isn't that correct?

04:45:36 10

04:45:40 11

A. We don't have PT-B measurements, but we have something -- you know, we -- that doesn't mean that we don't have a pressure because we do.

04:45:44 12

04:45:46 13

Q. I'm going to get to that. So what you did to pick your pressure to start your pressure curve was to take the initial reservoir pressure calculated during the MDT test, correct?

04:45:49 14

04:45:53 15

04:45:57 16

A. Correct.

04:45:57 17

04:46:01 18

Q. You agree with me, do you not, that that is a shut-in pressure? The well was not flowing at the time that that pressure was taken, correct?

04:46:05 19

04:46:06 20

A. True.

04:46:07 21

04:46:12 22

Q. It is not a flowing pressure, it is a shut-in pressure, correct?

04:46:12 23

A. Well, it is an initial pressure.

04:46:16 24

04:46:21 25

Q. A shut-in pressure, correct? The well was shut-in at the time the pressure measurement was taken?

04:46:22 1 A. Well, the well was not flowing because that's an MDT
04:46:26 2 measurement.

04:46:27 3 Q. You agree that what you did with respect to your
04:46:31 4 pre-May 8th data was to take the point of the shut-in pressure
04:46:37 5 measured before the explosion and draw a straight line down to
04:46:40 6 the May 8th pressure measured at the PT-B gauge, correct?

04:46:46 7 A. Yes. I mentioned, also, I think, that that may not be,
04:46:50 8 you know, exactly correct. The true would be a little more
04:46:55 9 concave, but it wouldn't be that much different.

04:47:00 10 Q. May I please have the ELMO for a moment.

04:47:02 11 Dr. Gringarten, I've put on the ELMO an excerpt from
04:47:06 12 your report, which, for convenience sake, I have marked as
04:47:10 13 D-21770.

04:47:12 14 THE COURT: He says can you move it over a little?

04:47:12 15 BY MS. HIMMELHOCH:

04:47:16 16 Q. I'm sorry, I absolutely can. Does that work better, sir?

04:47:16 17 A. Yes.

04:47:19 18 Q. This is a plot of your BOP datum pressure against your
04:47:25 19 assumed pressure, correct?

04:47:28 20 A. That's --

04:47:30 21 Q. Or your assumed pressure and the datum points from PT-B
04:47:34 22 gauge, correct?

04:47:34 23 A. Well, all of these are the PT-B gauge except for the first
04:47:40 24 point. Then the red line represent the interpolation between
04:47:47 25 points, neglecting the Top Kill --

04:47:50 1 Q. So what we're focused on right now is the part of this
04:47:54 2 curve that starts right near the Y axis and extends down to
04:47:58 3 May 8th, correct?

04:47:58 4 A. Yes.

04:47:59 5 Q. You indicated, as you said here and as you did in your
04:48:02 6 deposition, that, in fact, that curve could be more concave;
04:48:02 7 could it not?

04:48:07 8 A. It wouldn't be concave like this. It wouldn't go out.

04:48:10 9 Q. Yeah, I went too far down. But it could be --

04:48:13 10 A. It would be slightly more concave.

04:48:14 11 Q. Like that? It could be like that?

04:48:16 12 A. No, I don't think so. It would be, you know, less
04:48:22 13 concave. In other words, you know, the belly of that, you
04:48:29 14 know -- it would go more directly from the first point to the
04:48:32 15 last point.

04:48:32 16 Q. So something like this?

04:48:34 17 A. Yes.

04:48:34 18 Q. I'm going to call that Gringarten line. Okay?

04:48:34 19 A. Uh-huh (affirmative response).

04:48:43 20 Q. So if you had used that more concave line, you would have
04:48:48 21 had an additional flow during that time period, correct?

04:48:54 22 A. I would have, yes, at the higher rates.

04:48:58 23 Q. You would have had a higher flow rate for the period
04:49:01 24 before May 8th, correct?

04:49:01 25 A. That's correct.

04:49:02 1 Q. If you had a higher flow rate during the period of
04:49:04 2 April 20th to May 8th, you would have had a higher cumulative
04:49:08 3 volume of oil released, correct?

04:49:11 4 A. A slightly higher cumulative because the increase in
04:49:15 5 cumulative wouldn't be that great. It would be, you know, a
04:49:18 6 few percent.

04:49:18 7 Q. That's if you accept your line, which I've labeled the
04:49:22 8 Gringarten line, correct?

04:49:23 9 A. That's correct.

04:49:24 10 Q. But you present in your report no analysis for selecting
04:49:27 11 the Gringarten line as opposed to what I've labeled the US
04:49:31 12 line, do you?

04:49:32 13 A. No. But, taking, you know, a different interpolation is
04:49:38 14 reasonable, and I think I heard Dr. Griffiths do the same, if I
04:49:45 15 recall.

04:49:45 16 Q. You did not review Dr. Griffiths' report?

04:49:47 17 A. No, but I was sitting there when he made his presentation.

04:49:50 18 Q. But you did not present in your report an analysis that
04:49:53 19 gives a basis for choosing between the Gringarten line and the
04:49:58 20 US line, did you?

04:49:59 21 A. No. I said simply, you know, I took the interpolation.

04:50:02 22 Q. If you had accepted even your line, your cumulative volume
04:50:06 23 of oil, release would increase; would it not?

04:50:09 24 A. Yes, but by a small percent.

04:50:11 25 Q. If you used what I call the US line, it would be a greater

04:50:13 1 percent, correct?

04:50:14 2 A. Yes. I mean, you can, you know, do all the assumption.

04:50:19 3 You have also to look at, you know, how that would
04:50:23 4 affect the permeability that you have to get at the end.

04:50:27 5 Q. I understand that in your methodology you have to scale to
04:50:32 6 permeability, but still, if you start with a higher flow rate,
04:50:35 7 even if you're scaling to permeability, you will wind up at the
04:50:38 8 end with a higher cumulative?

04:50:41 9 A. Yes, it's a question of how much.

04:50:43 10 Q. You don't have any basis for saying how much?

04:50:45 11 A. No.

04:50:46 12 Q. Okay. Let's talk a little bit about a concept called
04:50:51 13 Skin. As I understand it, Skin is a measurement of the
04:50:55 14 resistance to flow between the reservoir face and the well,
04:50:58 15 correct?

04:50:59 16 A. And where you take the measurements.

04:51:02 17 Q. Okay. Let's go to TREX-016696R-N.0045.1.US. This will
04:51:17 18 require -- thank you.

04:51:17 19 This is a chart that we saw just a few moments
04:51:20 20 earlier in your direct examination, correct?

04:51:22 21 A. Correct.

04:51:22 22 Q. What you show here on this graph is that between May 8th
04:51:28 23 and the end of the spill, your Skin is small and rather
04:51:34 24 constant; isn't that correct?

04:51:35 25 A. Yes.

04:51:35 1 Q. In your deposition, did you not acknowledge that that
04:51:39 2 analysis therefore shows that there were no significant changes
04:51:43 3 in the wellbore between May 8 and the shut-in of the well?

04:51:47 4 A. If I recall, you said that -- and I concurred that it
04:51:52 5 implied that there was no change in the wellbore. However, as
04:52:00 6 I said in my direct, this part, you know, between May 8th and
04:52:10 7 July 15th -- and I mentioned that in my report -- is really the
04:52:15 8 result of a fit between the model and the data. It is by
04:52:23 9 default in the software attributed to the Skin because normally
04:52:28 10 you know the rate, and so the only other possibility is the
04:52:32 11 Skin, but it could be also due to the rate.

04:52:35 12 So I don't really -- the only thing what I can say
04:52:40 13 is, is this is the Skin. I cannot really -- and I think I
04:52:43 14 mentioned I don't have the data to qualify what the Skin
04:52:46 15 exactly means.

04:52:47 16 Q. You stated in your deposition, did you not, that your
04:52:52 17 analysis showed that after May 8th the Skin was constant and
04:52:55 18 rather small?

04:52:56 19 A. Yes.

04:52:59 20 MR. BOLES: Your Honor, I would just object. I think
04:53:00 21 if she's going to be asking him questions about what he said in
04:53:04 22 his deposition, it would be fair to put it up on the screen.

04:53:08 23 MS. HIMMELHOCH: Let's go ahead and call up his
04:53:10 24 deposition at page 220, beginning at line 7 and ending at
04:53:16 25 line 21.

04:53:20 1 BY MS. HIMMELHOCH:

04:53:20 2 Q. I began by asking you the question, "You did not in your
04:53:23 3 work take into account any changes in the wellbore between
04:53:26 4 April 20th and the shut-in of the well?"

04:53:28 5 There is an objection.

04:53:29 6 You say, "What do you mean by wellbore work?"

04:53:31 7 I say, "Any erosion in the wellbore."

04:53:34 8 There is another objection.

04:53:35 9 You say, "No, but the analysis shows that after
04:53:38 10 May 8th, the Skin is constant and rather small."

04:53:41 11 Did I ask you that question, and did you give that
04:53:44 12 answer?

04:53:44 13 A. Yes, and that's what I just said as well.

04:53:46 14 Q. Okay. Then I asked you, "Which implies that there is not
04:53:52 15 a significant change in the wellbore over time, correct?" And
04:53:55 16 you said, "Correct."

04:53:57 17 Were you asked that question, and did you give that
04:53:58 18 answer?

04:53:59 19 A. Yes.

04:53:59 20 Q. Thank you. Let's move on.

04:54:01 21 Now, you state --

04:54:02 22 A. But, you know, I think we should also take into account
04:54:05 23 what I said during his direct, which is this Skin here is a
04:54:10 24 result of the match between the data and the model.

04:54:17 25 I mentioned in my deposition, by the way, that I had

04:54:22 1 no information to able to state what was going on in the
04:54:25 2 wellbore.

04:54:25 3 Q. But your analysis certainly implies that there were no
04:54:29 4 significant changes after May 8th?

04:54:31 5 A. No. The analysis imply that the Skin is rather constant.

04:54:37 6 Q. Let's move on then to a question about your assumed
04:54:41 7 flow rates.

04:54:42 8 In your testimony, you referenced the fact that you
04:54:44 9 had evidence that there was -- the flow at the end of the
04:54:47 10 period was roughly 48,000 barrels per day, correct?

04:54:55 11 A. I gave a range, I believe.

04:54:57 12 Q. That range you took from an expert that BP selected not to
04:55:01 13 testify today, correct?

04:55:02 14 A. That's correct.

04:55:02 15 Q. Let's call up D-24222.

04:55:11 16 On this graph that you were shown by opposing
04:55:15 17 counsel, you showed a flow rate at the end of 42,400, and you
04:55:19 18 referenced that as the Dykhuizen flow rate, correct?

04:55:24 19 A. Well, yeah. I showed that point.

04:55:26 20 Q. Now, it's fair to say, is it not, that before you --
04:55:29 21 before you issued your report, you had never read the report of
04:55:33 22 Dr. Dykhuizen, correct?

04:55:36 23 A. I don't recall if I did or not.

04:55:37 24 Q. In your deposition, you were asked whether you had read
04:55:40 25 his report --

04:55:40 1 A. Yes. But then I did read it, yeah.

04:55:43 2 Q. At your deposition, you still hadn't read the report of
04:55:46 3 Dr. Dykhuizen; isn't that correct?

04:55:47 4 A. Since. Since my deposition.

04:55:49 5 Q. At your deposition, you had not yet read his report,
04:55:49 6 correct?

04:55:53 7 A. Correct.

04:55:53 8 Q. So Dr. Dykhuizen's flow rate cannot be the basis for your
04:55:58 9 putting this flow rate number at 42,400 on the last day; isn't
04:56:04 10 that correct?

04:56:04 11 A. Well, he was down here for illustration.

04:56:11 12 Q. But you did not pull that number from Dr. Dykhuizen's
04:56:14 13 report, did you?

04:56:16 14 A. No, I did not.

04:56:16 15 Q. In fact, Dr. Dykhuizen's best estimate of the flow rate on
04:56:20 16 that last day is 53,000 stock-tank barrels per day; isn't that
04:56:25 17 correct?

04:56:25 18 A. I think his number is corrected for the difference in the
04:56:29 19 formation volume factor.

04:56:31 20 Q. You're aware, are you not, that Dr. Dykhuizen testified
04:56:34 21 that he used a single-stage flash?

04:56:37 22 A. Okay.

04:56:38 23 Q. So Dr. Dykhuizen used a single-stage flash, just like you
04:56:41 24 did, correct?

04:56:42 25 A. Yes.

04:56:42 1 Q. Dr. Dykhuizen stated that his best estimate was 53,000
04:56:47 2 stock-tank barrels per day, correct?

04:56:48 3 A. Okay, if you say so right now.

04:56:49 4 Q. Therefore, your flow curves do not match the value that's
04:56:55 5 the measured value at the end of the flow period; isn't that
04:56:59 6 correct, even with your higher permeability value?

04:57:01 7 A. Well, it does match the value that were given which, you
04:57:06 8 know, started my process, which was given by the BP expert
04:57:10 9 which is no longer -- which has not been in deposition -- I
04:57:15 10 mean, has not testified.

04:57:16 11 Q. And whose report is not in evidence, whose estimate is not
04:57:20 12 in evidence, correct?

04:57:22 13 A. Yeah. But the fact is, you know, when I did the work, he
04:57:26 14 was a BP expert.

04:57:28 15 Q. But it is true that if you accept Dr. Dykhuizen's estimate
04:57:31 16 and use 53,000 stock-tank barrels per day, neither your lower
04:57:37 17 nor higher estimate would hit the measured value on the final
04:57:40 18 flow day; isn't that correct?

04:57:43 19 A. Yes. Then I would not accept, you know, his number, you
04:57:46 20 know, because these are my numbers and --

04:57:48 21 Q. Are you aware of any BP expert who has provided an
04:57:53 22 estimate, other than the one that BP chose not to call and not
04:57:56 23 to put into evidence, are you aware of any BP expert who offers
04:57:59 24 an opinion regarding the value of the flow rate on the final
04:58:02 25 day?

04:58:04 1 A. I don't recall.

04:58:05 2 Q. There is no BP expert testifying as to what the value is
04:58:09 3 on the last day, correct?

04:58:11 4 A. Okay, if you say so.

04:58:13 5 Q. Therefore, the only testimony that this Court has heard
04:58:16 6 regarding the flow rate on that last day is Dr. Dykhuizen,
04:58:19 7 whose best estimate is 53,000; isn't that correct?

04:58:22 8 A. Yes.

04:58:24 9 Q. Okay. Let's move on to --

04:58:28 10 A. But, you know -- I think that's fine, but that's not too
04:58:31 11 relevant for -- my results are what I've shown here.

04:58:34 12 Q. Yes, and they do not match that measured flow rate on the
04:58:39 13 final day?

04:58:40 14 A. Yes.

04:58:40 15 Q. Okay. Let's move on to another topic, and that is just to
04:58:44 16 confirm my understanding of how you obtained your
04:58:47 17 bottomhole pressures.

04:58:48 18 As we discussed, Dr. Johnson converted your
04:58:52 19 wellhead pressures to bottomhole pressures using your assumed
04:58:56 20 flow rate, correct?

04:58:57 21 A. Correct.

04:58:57 22 Q. You did not review Dr. Johnson's calculations for
04:59:01 23 accuracy, did you?

04:59:01 24 A. No. Because, you know, the way I work and, I suppose,
04:59:04 25 other people work is you work with experts. The idea of using

04:59:10 1 experts is that you don't need to second guess them. So, you
04:59:13 2 know, he has the expertise, I don't have it. So that's logical
04:59:17 3 that, you know, I use his result and trust him.

04:59:24 4 Q. In other words, you don't independently have a basis for
04:59:28 5 agreeing or disagreeing with his conversion to
04:59:31 6 bottomhole pressures, correct?

04:59:32 7 A. I have no reason to disagree or not disagree with him.

04:59:38 8 Q. Because these bottomhole rates are what you treated as
04:59:41 9 your ground truth, once they were converted, if there is an
04:59:44 10 error in Dr. Johnson's calculation of those bottomhole
04:59:47 11 pressures, that error would affect the accuracy of your
04:59:49 12 estimate of the cumulative volume of oil released, would it
04:59:51 13 not?

04:59:51 14 A. True, but I assume there is no error.

04:59:53 15 Q. You assume, but you have not investigated?

04:59:56 16 A. No. But being an expert, you know, in the same way as,
04:59:59 17 you know, I would say -- you know, my clients trust my
05:00:05 18 expertise and don't question my results, you know, I trust
05:00:11 19 Dr. Johnson's expertise and didn't question his results.

05:00:14 20 Q. Now, you talked a bit about -- or quite a bit about
05:00:20 21 deconvolution in both your cumulative volume estimate and your
05:00:25 22 permeability estimate. Right now, I'm going to focus on your
05:00:27 23 use of deconvolution in your cumulative volume estimate, not in
05:00:32 24 the permeability estimate. Okay?

05:00:33 25 A. Okay.

05:00:34 1 Q. Isn't it true that as you used deconvolution in your
05:00:38 2 cumulative volume of oil estimate, deconvolution was a means of
05:00:42 3 determining your reservoir characteristics or interpretation
05:00:46 4 model?

05:00:47 5 A. I'm not sure I understand the question.

05:00:49 6 Q. Isn't it true that the method -- that the reason you used
05:00:53 7 deconvolution was so that you could define your interpretation
05:00:57 8 model?

05:00:58 9 A. It does both. My primary objective here was not to obtain
05:01:04 10 a model from the reservoir, but to, you know, find the flow
05:01:11 11 rates. Deconvolution does both.

05:01:16 12 So, you know, all through my -- you know, as I say.
05:01:20 13 I've used deconvolution in different ways.

05:01:23 14 Q. It's true, is it not, that one of the ways that you used
05:01:28 15 deconvolution was to arrive at your interpretation model or
05:01:31 16 your description of the reservoir?

05:01:32 17 A. That was, you know, one of the output, in addition to
05:01:37 18 finding the rates.

05:01:37 19 Q. Isn't it true that if your interpretation model -- isn't
05:01:42 20 it true that your interpretation model is an off-centered well
05:01:46 21 in a long, narrow reservoir with sealed boundaries?

05:01:49 22 A. Yes.

05:01:49 23 Q. Isn't it also true that Dr. Pooladi-Darvish's
05:01:54 24 interpretation model is an off-centered well in a long, narrow
05:01:58 25 reservoir with sealed boundaries?

05:01:59 1 A. Well, I don't think there has been any dispute among all
05:02:02 2 of the experts about the shape of the reservoir. There might
05:02:05 3 have been a dispute about the size, definitely about the
05:02:09 4 permeability, but not the shape.

05:02:10 5 Q. So you agree with Dr. Pooladi-Darvish's interpretation
05:02:14 6 model as an off-centered well in a long, narrow reservoir with
05:02:20 7 sealed boundaries?

05:02:21 8 A. Yeah. Not only with Dr. Pooladi-Darvish. I guess, you
05:02:25 9 know, all the -- all the experts came to that conclusion.

05:02:29 10 Q. In developing your opinions in the case, you reviewed the
05:02:34 11 deposition of Mike Levitan; isn't that correct?

05:02:36 12 A. Yes.

05:02:37 13 Q. And Dr. Levitan was a BP employee during the response,
05:02:43 14 wasn't he?

05:02:43 15 A. Yes.

05:02:43 16 Q. Not only was he a BP employee during the response, he's
05:02:48 17 also someone who was the author of several of the articles
05:02:50 18 relating to deconvolution that you cited in Appendix D of your
05:02:56 19 report; isn't that correct?

05:02:56 20 A. That's correct.

05:02:56 21 Q. In his deposition, Dr. Levitan testified that he was
05:02:59 22 performing some estimates of flow rates using build-up
05:03:03 23 pressures from the shut-in; isn't that correct?

05:03:05 24 A. Yes.

05:03:05 25 Q. Dr. Levitan testified that because he did not have flow

05:03:09 1 rate information, deconvolution did not reveal any more
05:03:11 2 information for him in his analysis; isn't that correct?

05:03:13 3 A. That's what he said.

05:03:15 4 Q. Let's move on now to --

05:03:16 5 A. I must also add that, you know, obviously, we must
05:03:20 6 disagree somewhere, because, you know, I find it possible from,
05:03:25 7 you know, deconvolution to calculate the rate.

05:03:27 8 So, you know, I cannot speculate on the reason why
05:03:31 9 Dr. Levitan didn't -- you know, decided not to calculate the
05:03:35 10 rate because I could.

05:03:37 11 Q. But you'll agree that Dr. Levitan found that deconvolution
05:03:41 12 did not add any information?

05:03:43 13 A. That's what he said during his deposition.

05:03:44 14 Q. Let's move on to focus a little bit on how your cumulative
05:03:49 15 estimate of oil released compares to the other estimates that
05:03:53 16 BP has offered.

05:03:53 17 Now your highest -- I apologize, I'm talking too
05:03:58 18 fast. I will slow down.

05:04:01 19 Let's talk a little bit about how your cumulative
05:04:05 20 volume of oil release compares to other estimates.

05:04:10 21 First, I just want to make sure that we're all clear.
05:04:12 22 Your highest estimate of cumulative volume of oil released is
05:04:16 23 below that of what Dr. Blunt has offered; isn't that correct?

05:04:19 24 A. If I recall, we overlap. I think his numbers are from
05:04:26 25 2.9 to 3.7. I don't remember exactly. My number is from

05:04:32 1 2.4 to 3, so obviously we overlap.

05:04:35 2 Q. You understand that he has offered as his best estimate

05:04:40 3 3.26; isn't that correct?

05:04:41 4 A. Yes, that's a best estimate.

05:04:44 5 Q. Your highest value is below that best estimate; isn't that

05:04:48 6 correct?

05:04:49 7 A. Yes, but you cannot compare a fixed value with a range.

05:04:55 8 You know, I provided a range. Dr. Blunt -- we are talking

05:04:59 9 about Dr. Blunt, right?

05:05:01 10 Q. Yes, sir.

05:05:01 11 A. -- he is providing a range, but he's, you know, also

05:05:06 12 decide to use my P10 value for permeability. So he has been on

05:05:12 13 the, you know, P10 side of my estimates.

05:05:17 14 Q. Well, we'll get into your permeability estimate in a bit.

05:05:22 15 Let's call up TREX-130529.0 -- sorry, 130529.

05:05:33 16 Dr. Gringarten, this is the Annual Report of BP from

05:05:36 17 2011, correct?

05:05:37 18 A. Well, that's the first time I see it, so --

05:05:37 19 Q. But it says --

05:05:40 20 A. -- but that's what it says on --

05:05:41 21 Q. Let's go to TREX-130529.236.1.US. Maybe if you could make

05:05:52 22 that blowup a little bit bigger.

05:05:56 23 MR. BOLES: Your Honor, I'm going to object to this

05:05:58 24 line of questioning. Clearly, Dr. Gringarten doesn't have a

05:06:01 25 foundation for interpreting statements from BP's Annual Report.

05:06:05 1 MS. HIMMELHOCH: This Annual Report sets forth an
05:06:08 2 estimate of oil based on the work of experts, and I'm entitled
05:06:11 3 to inquire into Dr. Gringarten --

05:06:13 4 THE COURT: All right. I'll let you go. Let's see
05:06:16 5 where it goes.

05:06:17 6 MS. HIMMELHOCH: Thank you, Your Honor.

05:06:17 7 BY MS. HIMMELHOCH:

05:06:19 8 Q. Dr. Gringarten, you're aware, now that you're reading
05:06:23 9 this, that in its report to its shareholders BP reported that
05:06:26 10 they were using an estimate of total flow from the well of
05:06:29 11 approximately four million barrels; that's what they said in
05:06:32 12 their Annual Report, correct? The lower highlighting.

05:06:36 13 A. Yes.

05:06:37 14 Q. Did you have any input into that estimate of approximately
05:06:41 15 four million barrels?

05:06:42 16 A. No.

05:06:42 17 Q. In fact, your estimate of the flow rate is a million
05:06:47 18 barrels below the estimate that BP stated to its shareholders;
05:06:50 19 isn't that correct?

05:06:51 20 A. Yes.

05:06:51 21 Q. Let's go on to another document.

05:06:53 22 THE COURT: That document was from what, an Annual
05:06:56 23 Report, you said?

05:06:57 24 MS. HIMMELHOCH: It's their Annual Report. It's the
05:07:00 25 company's Annual Report from 2011, sir.

05:07:04 1 THE COURT: Is that in evidence?

05:07:05 2 MS. HIMMELHOCH: We will be moving it into evidence,
05:07:07 3 sir.

05:07:08 4 THE COURT: Okay.

05:07:08 5 BY MS. HIMMELHOCH:

05:07:10 6 Q. Dr. Gringarten, I'm going to now call up TREX-144820.

05:07:17 7 This is a staff working paper prepared by the
05:07:20 8 National Commission on the BP Deepwater Horizon Oil Spill.

05:07:23 9 If we can go to TREX-114820.2.1.US. I'm sorry, I got
05:07:33 10 the wrong number. I'm looking -- it's TREX number -- the page
05:07:37 11 that's stamped TREX-144820.0019. Yes, that's the call-out I'm
05:07:47 12 looking for.

05:07:47 13 The National Commission staff concluded that, "The
05:07:50 14 emerging consensus among government and independent scientists
05:07:53 15 is that roughly five million barrels of oil were released by
05:07:56 16 the Macondo Well."

05:07:57 17 Assuming for a moment that that emerging consensus is
05:08:00 18 correct, your estimate is two million barrels of oil below what
05:08:04 19 the staff of the National Commission concluded was the emerging
05:08:09 20 consensus; isn't that correct?

05:08:11 21 MR. BOLES: Your Honor, again, I would object. The
05:08:12 22 witness -- there is no foundation established that this witness
05:08:14 23 knows what this document is. There is no context provided
05:08:18 24 here.

05:08:19 25 THE COURT: Well, I mean, really, the answer to that

05:08:24 1 question is self-evident. Somebody else said five, and he said
05:08:29 2 three.

05:08:29 3 MR. BOLES: Exactly.

05:08:30 4 THE COURT: Obviously, it's different.

05:08:31 5 MR. BOLES: If she wants to inquire into his numbers
05:08:34 6 and whether they are higher or lower, that's one thing, in his
05:08:37 7 analysis, but to compare them to snippets of documents where,
05:08:37 8 for example, on the last one we don't -- the last document, we
05:08:41 9 don't know where that --

05:08:41 10 THE COURT: We've had a lot of snippets in this trial
05:08:44 11 so far.

05:08:44 12 MS. HIMMELHOCH: Your Honor, I simply would ask him to
05:08:44 13 make an objection.

05:08:44 14 THE COURT: I'll overrule the objection, but I don't
05:08:51 15 think you ought to go too far down this road.

05:08:54 16 MS. HIMMELHOCH: I am done with this document,
05:08:55 17 Your Honor.

05:08:55 18 THE COURT: Okay, good.

05:08:55 19 BY MS. HIMMELHOCH:

05:08:56 20 Q. Now, Dr. Gringarten, your entire report is going into
05:09:01 21 evidence here, so I want to inquire about a couple of things
05:09:03 22 that you didn't talk about directly on your direct.

05:09:07 23 The first is, you were asked whether compressibility
05:09:11 24 was an input into your analysis. You said no, correct?

05:09:19 25 A. Well, I mean, I'm not -- it is an input into my analysis.

05:09:25 1 Q. That was what I was trying to clear up. It is an input
05:09:26 2 into your permeability analysis?

05:09:28 3 A. Yeah, but I thought the question was what's the inference
05:09:30 4 of it. I must have missed the question.

05:09:31 5 Q. Before we go further on compressibility, if Dr. Blunt uses
05:09:43 6 your P50 permeability as opposed to your P90 permeability --
05:09:47 7 or, sorry, P10 permeability, his cumulative discharge is still
05:09:52 8 outside your range, is it not?

05:09:55 9 A. Well, he's used the -- my P10 permeability, but then he
05:10:02 10 has used his own analysis for the size of the reservoir in some
05:10:11 11 spots. So his final results, you know, depend not entirely on
05:10:17 12 his choice of my P10 permeability.

05:10:20 13 In fact, he used my P10 permeability, if I
05:10:23 14 understand, to evaluate the conductivity of the reservoir,
05:10:29 15 among other things. So there is no clear relationship between
05:10:34 16 his choice of my P10 and the fact that he gets something which
05:10:37 17 is different from what I get.

05:10:38 18 Q. When Dr. Blunt was testifying, he acknowledged that if he
05:10:41 19 used your P50 permeability value, his reservoir thickness had
05:10:46 20 to be over 100 feet. You do not agree with a reservoir height
05:10:50 21 of greater than one hundred feet, do you?

05:10:52 22 A. No, and I don't recall that in his deposition. Could I
05:10:58 23 see?

05:10:58 24 Q. It was during the trial here, sir.

05:11:00 25 A. Yes. But I don't -- I recall some discussion about

05:11:05 1 changing some numbers in his spreadsheet, which he said was
05:11:12 2 totally appropriate.

05:11:13 3 Q. Well, let me ask you: Did you agree with him that that
05:11:16 4 was inappropriate?

05:11:16 5 A. Yes. I mean, I -- well, that's what he said. I don't
05:11:21 6 know his spreadsheet, so I don't know what he had in his
05:11:24 7 spreadsheet, but it's certain that spreadsheet is set up in a
05:11:29 8 certain way, and you cannot, you know, at random put numbers in
05:11:31 9 it.

05:11:32 10 What he said, if I recall, is that if you want to
05:11:35 11 change the -- then you have to change the thickness, which
05:11:39 12 means you have to go within the spreadsheet and do some
05:11:43 13 adjustment.

05:11:43 14 Q. You've reviewed the work of Dr. Pooladi-Darvish, correct?

05:11:47 15 A. Yes.

05:11:48 16 Q. Dr. Pooladi-Darvish performed a reservoir simulation;
05:11:51 17 isn't that correct?

05:11:51 18 A. Yes.

05:11:51 19 Q. Wouldn't the same principle hold true that you can't
05:11:55 20 simply pluck one value out of his analysis and come to a
05:11:57 21 conclusion about its effect on his analysis? You would have to
05:11:59 22 go back and look at the entire reservoir simulation; isn't that
05:12:02 23 true?

05:12:02 24 A. I just look at the results. You know, I didn't have --
05:12:07 25 you know, we're talking about something totally different here.

05:12:11 1 From what I understand from reading the testimony,
05:12:14 2 that the government, you know, wanted to modify a number in his
05:12:22 3 spreadsheet, and that's, you know, totally different than just
05:12:26 4 looking at, you know, the results displayed by
05:12:31 5 Dr. Pooladi-Darvish. We're talking about something totally
05:12:34 6 different here.

05:12:34 7 Q. You agree, do you not, that when you perform a reservoir
05:12:38 8 simulation, simply pulling out one number and plugging in
05:12:41 9 another one would not honor the way in which reservoir
05:12:46 10 simulations are performed?

05:12:52 11 A. Well, with respect to what? I'm not sure I understand
05:12:58 12 what we are --

05:12:58 13 Q. You criticized --

05:12:59 14 A. -- trying to do here.

05:13:00 15 Q. I'm sorry, I did not mean to talk over you.

05:13:04 16 You criticized the United States because you said it
05:13:05 17 was inappropriate to pull a single value out of Dr. Blunt's
05:13:10 18 analysis without considering the effect of that single value on
05:13:14 19 his other inputs?

05:13:14 20 A. But, again, I think we are talking about --

05:13:17 21 Q. Sir, I haven't asked you a question yet. I apologize, but
05:13:20 22 let me finish my question.

05:13:22 23 So you made that criticism of the United States'
05:13:25 24 counsel, and I'm asking you, wouldn't it be fair to make the
05:13:27 25 same criticism if BP's counsel attempted to take a single value

05:13:32 1 out of a reservoir simulation and, without considering the
05:13:35 2 effect of that on other parameters, assumed what the result of
05:13:39 3 that change would be?

05:13:40 4 A. I'm, you know, a little lost here.

05:13:48 5 If, you know, for instance we had access to
05:13:56 6 Dr. Pooladi-Darvish's simulator, and then I plug a number, and
05:14:02 7 then I say, how are we this much, then that would be the
05:14:04 8 equivalent, the equivalent to defining Dr. Blunt's exam sheet,
05:14:10 9 but we are talking about something totally different here.

05:14:13 10 Q. Well, we'll move on then.

05:14:14 11 Let's talk for a moment about your compressibility
05:14:17 12 calculation. You did calculate a total permeability for this
05:14:20 13 reservoir of approximately 18 to 19 microsips, correct?

05:14:26 14 A. Sorry, could you repeat the question? Sorry.

05:14:28 15 Q. I must have said the wrong thing. You calculated a total
05:14:33 16 compressibility for this reservoir of approximately 18 to
05:14:37 17 19 microsips, correct?

05:14:38 18 A. Yeah. Possibly, I did, but okay.

05:14:39 19 Q. Do you want to see the page in your report?

05:14:43 20 A. Well, I trust you. There is no argument.

05:14:45 21 Q. Why don't we just make sure.

05:14:48 22 Let's call up TREX-11696R.0073. If we could call out
05:14:58 23 the lower table there.

05:14:58 24 This is a presentation of your Monte-Carlo analysis
05:15:05 25 of your compressibility numbers for the M56D and E, correct?

05:15:13 1 A. Okay.

05:15:13 2 Q. And your P50 values range from 17.84 to 18.62?

05:15:18 3 A. Yes.

05:15:19 4 Q. So I was mistaken. I'm glad you made us check.

05:15:20 5 Your permeability ranges, if you average those two

05:15:22 6 numbers, somewhere around 18 microsips; is that correct?

05:15:25 7 A. That's correct.

05:15:25 8 Q. In order to calculate that total compressibility you

05:15:33 9 needed an input for rock compressibility, correct?

05:15:35 10 A. That's correct.

05:15:36 11 Q. You took that input directly from Dr. Zimmerman, correct?

05:15:40 12 A. That's correct.

05:15:41 13 Q. You did not do any analysis to satisfy yourself that that

05:15:44 14 was the appropriate number for the rock compressibility; isn't

05:15:47 15 that correct?

05:15:47 16 A. Again -- that's correct. Again, you know,

05:15:52 17 Professor Zimmerman is the expert, and therefore, you know, I

05:15:54 18 have no reason to second check it.

05:15:58 19 Besides, as I mentioned before, the compressibility

05:16:02 20 has no bearing from my analysis. You know, compressibility

05:16:05 21 will change the size of the reservoir, but not the

05:16:10 22 permeability.

05:16:11 23 So my focus on the analysis was the permeability.

05:16:15 24 So, you know, that number is really incidental to my analysis.

05:16:19 25 Q. You do present, however, an estimate of the connected

05:16:22 1 volume in the reservoir, correct?

05:16:24 2 A. Yes.

05:16:25 3 Q. Does compressibility play into that estimate?

05:16:28 4 A. Yes, but it doesn't play in my calculation of the total
05:16:34 5 discharge.

05:16:34 6 Q. Okay. Well, we'll come to your calculation of original
05:16:37 7 oil in place in a moment.

05:16:39 8 With respect to the fluid analysis, and particularly
05:16:42 9 the Appendix A of your report, that's a fluids analysis that
05:16:47 10 was drawn entirely from the work of Dr. Whitson, correct?

05:16:51 11 A. Yes.

05:16:51 12 Q. Again, you did not do any independent verification of
05:16:55 13 that?

05:16:55 14 A. Yeah, for the same reasons.

05:16:58 15 Q. You testified on direct that you used a single stage
05:17:01 16 formation volume factor for your conversion to
05:17:04 17 stock-tank barrels, correct?

05:17:05 18 A. Yes.

05:17:05 19 Q. Again, you did that in relying entirely on Dr. Whitson for
05:17:10 20 the propriety of using a single-stage flash, correct?

05:17:13 21 A. Correct.

05:17:14 22 Q. Let's move on to the question of reservoir height.

05:17:18 23 I just want to confirm, Dr. Gringarten, that you used
05:17:22 24 a reservoir thickness of 93 feet?

05:17:24 25 A. Correct.

05:17:24 1 Q. Dr. Blunt says the reservoir is thinner than 93 feet away
05:17:29 2 from the well. Do you agree with that contention?

05:17:34 3 A. Well, I agree that that may be the case. In my case,
05:17:41 4 there is -- no, if I'm doing well test analysis, okay. In
05:17:46 5 well test analysis, as I've explained before, which was the
05:17:51 6 schematic we showed, you know, we rely on the pressure signal,
05:17:56 7 and especially the derivative, as information on, you know, the
05:18:02 8 size and the characteristics and the concave -- of the
05:18:08 9 reservoir.

05:18:09 10 If there was -- so for my well test analysis of the
05:18:14 11 build-up after July 15th, there is no evidence of a change in
05:18:24 12 thickness. Okay. So within the distance reached, you know,
05:18:30 13 during -- you know, the pressure -- by the pressure signal
05:18:34 14 during the -- you know, subsequent to build-up, I don't see any
05:18:37 15 change in thickness.

05:18:38 16 If there were a change which is significant, I would,
05:18:45 17 you know, see it because what well test analysis sees is change
05:18:50 18 in mobility, which are permeability, thickness divided by
05:18:54 19 viscosity, or a change in store activity, which is
05:18:59 20 compressibility times porosity and thickness. If I don't see
05:19:07 21 any change, then, you know, I have no reason to -- that's it.

05:19:09 22 Q. So, in your opinion, the reservoir has a thickness of
05:19:14 23 93 feet?

05:19:15 24 A. That's what I see from my well test analysis.

05:19:18 25 Q. Let's go ahead and call up D-21161.

05:19:29 1 Dr. Gringarten, isn't it correct that four of BP's
05:19:32 2 experts in this case come from the same Imperial College in
05:19:37 3 London?

05:19:37 4 A. Yes.

05:19:37 5 Q. Isn't it true that Imperial College conducts research for
05:19:44 6 BP in the area of reservoir characterization?

05:19:47 7 A. I suppose so. I'm not aware of the details exactly.

05:19:52 8 Q. You were aware, at least since your deposition, that
05:19:56 9 Imperial College of London is one of the recipients of a
05:20:02 10 hundred million dollar Grant that BP gave to colleges to
05:20:04 11 conduct research into reservoir characterization; isn't that
05:20:07 12 correct?

05:20:07 13 A. I don't think you mentioned it in my deposition, but I
05:20:10 14 heard it from the testimony of Dr. Blunt. That's the first
05:20:14 15 time I heard about it. But, yes, I suppose so.

05:20:16 16 Q. You have no reason to deny that fact?

05:20:19 17 A. No.

05:20:19 18 Q. Let's go ahead and call up D-21781.

05:20:28 19 Dr. Gringarten, you explicitly rely on your
05:20:31 20 colleagues from the Imperial College in your work. You use
05:20:37 21 Dr. Blunt's conversion of capping stack pressures in your
05:20:39 22 analysis, you used Dr. Zimmerman's number for
05:20:43 23 rock compressibility, and you used Dr. Trusler's correction of
05:20:49 24 the PT-B pressures; isn't that correct?

05:20:52 25 A. That's correct.

05:20:52 1 Q. If we can go ahead and call up D-21783.

05:20:57 2 In addition, you relied directly on Dr. Whitson and
05:21:01 3 Dr. Johnson for additional information in your analysis,
05:21:01 4 correct?

05:21:03 5 A. That's correct.

05:21:03 6 Q. If any of these individuals have made an error in his
05:21:08 7 analysis, that error would carry through into your analysis;
05:21:12 8 isn't that correct?

05:21:16 9 A. To, you know, different degrees.

05:21:19 10 Q. Let's now turn to what we were talking about earlier,
05:21:22 11 which is your original oil in place estimate.

05:21:25 12 Your original oil in place estimate is based upon
05:21:27 13 your pressure transient analysis or your well test analysis,
05:21:31 14 correct?

05:21:32 15 A. That's correct.

05:21:32 16 Q. Your original oil in place, therefore, represents an
05:21:35 17 estimate of the connected volume of the reservoir, correct?

05:21:37 18 A. That's correct.

05:21:38 19 Q. When you derive an estimate of connected volume from a
05:21:43 20 pressure transient analysis or well test analysis, your
05:21:46 21 estimate of connected volume will be directly related to your
05:21:49 22 estimate of permeability; isn't that correct?

05:21:51 23 A. Yes. Yes.

05:21:56 24 Q. Therefore, if your permeability estimate were in error,
05:22:01 25 that would change your estimate of connected volume as well,

05:22:04 1 wouldn't it?

05:22:04 2 A. Yes.

05:22:07 3 Q. Now, Dr. Blunt also calculated his connected area using a
05:22:13 4 pressure transient analysis, did he not?

05:22:14 5 A. Yes.

05:22:15 6 Q. Therefore, his connected area is dependent on
05:22:21 7 permeability, correct?

05:22:23 8 A. Yeah. He's using permeability for the connectivity.

05:22:27 9 Q. Your well test analysis honors the principle of the
05:22:34 10 material balance, does it not?

05:22:35 11 A. Yes.

05:22:35 12 Q. Dr. Blunt used material balance in his analysis, didn't
05:22:38 13 he?

05:22:38 14 A. Yes.

05:22:38 15 Q. Yet Dr. Blunt's connected volume does not vary
05:22:43 16 proportionally with his permeability; isn't that correct?

05:22:45 17 A. I don't know. I haven't made the calculation.

05:22:50 18 Q. You've reviewed his report?

05:22:52 19 A. Yes, but I don't recall -- he provides a relationship
05:22:56 20 between permeability and his volume.

05:22:59 21 Q. But you don't know?

05:23:02 22 A. Well --

05:23:02 23 Q. Let's move on now --

05:23:05 24 A. But, you know, the relationship -- and I think we
05:23:08 25 covered -- we discussed that in my deposition, the distance is

05:23:14 1 proportionate to the square root of the permeability and
05:23:19 2 inversely proportional to the total compressibility. So there
05:23:25 3 is a relationship. It's not a linear relationship, but it is a
05:23:26 4 relationship.

05:23:26 5 Q. It is true, is it not, that permeability is -- the square
05:23:36 6 root of permeability is directly proportional to the
05:23:40 7 distance -- or the width of the reservoir, correct?

05:23:43 8 A. You mean horizontally?

05:23:46 9 Q. Horizontally, yes.

05:23:50 10 A. Yes.

05:23:50 11 Q. The square root of permeability is also directly
05:23:54 12 proportional to the length of the reservoir, correct?

05:23:57 13 A. Yes.

05:23:57 14 Q. Area is calculated by multiplying length times width,
05:24:01 15 correct?

05:24:01 16 A. Yes.

05:24:01 17 Q. Therefore, isn't corrected area directly proportional to
05:24:07 18 permeability?

05:24:07 19 A. Yeah, I would say.

05:24:08 20 Q. Now, let's go on to your calculation of permeability.

05:24:15 21 You indicated in your direct testimony that the
05:24:20 22 pumping goes on for three to four hours in the MDT test,
05:24:25 23 correct?

05:24:25 24 A. That's correct.

05:24:26 25 Q. But it's not continuous pumping, is it?

05:24:28 1 A. No. As I indicated, from time to time the tool is
05:24:32 2 shut-in, and therefore there are some build-ups in between.

05:24:35 3 Q. When the well is shut-in just before the final pretest,
05:24:40 4 which is what you analyzed, it has essentially returned to
05:24:45 5 initial reservoir pressure, has it not?

05:24:46 6 A. I don't recall. Yeah, I don't recall. I'm not sure.

05:24:53 7 Q. You don't have any reason to dispute that right now, do
05:24:53 8 you?

05:24:56 9 A. Well, normally, when you shut it, it takes quite a while
05:25:01 10 before you go back to the initial pressure. So yes, I would
05:25:06 11 not agree with that.

05:25:06 12 Q. How much fluid is withdrawn in a pretest?

05:25:12 13 A. A pretest, 20 cc's, but that's not what we're talking
05:25:16 14 about here. Here we are talking about, you know, four hours of
05:25:20 15 pumping.

05:25:20 16 Q. Four hours of pumping followed by a shut-in?

05:25:20 17 A. Yes.

05:25:24 18 Q. Followed by a pretest that withdraws 20 cc's or
05:25:30 19 1 1/3 tablespoons?

05:25:31 20 A. That's right. That's what is important, and that's where
05:25:34 21 the conversion comes in, is that what has been produced is
05:25:37 22 4 hours of fluid.

05:25:38 23 Q. Four hours of fluid interrupted by a shut-in?

05:25:46 24 A. Yes. But that doesn't matter.

05:25:48 25 Q. Let's talk about -- just to confirm, I think this is clear

05:25:52 1 to the judge now, but I just want to make sure it's absolutely
05:25:56 2 clear. Your estimate of cumulative volume of oil released is
05:25:59 3 directly related to your permeability?

05:26:01 4 A. Yes.

05:26:01 5 Q. And so if your permeability is doubled, then your volume
05:26:06 6 of oil would be doubled, correct?

05:26:08 7 A. Yeah, about.

05:26:11 8 Q. Now, you agree, do you not, that Dr. Blunt has stated in
05:26:13 9 his report that permeability is typically the most uncertain
05:26:17 10 parameter in reservoir engineering analysis, are you not?

05:26:22 11 A. Well, yes, he said that's uncertain, but he also said
05:26:28 12 that, you know, the best way to get permeability is from a
05:26:32 13 test.

05:26:32 14 Q. Right. But he -- even with that, he states that
05:26:36 15 permeability is typically the most uncertain parameter?

05:26:41 16 A. In general, I would dispute that. Because that's -- you
05:26:45 17 know, that's my business. I mean, I'm an expert in well test
05:26:48 18 analysis. And my expertise leads me to have quite confidence
05:26:57 19 on the permeability I get from well test analysis.

05:27:06 20 Q. The resolution of the pressure gauge in the MDT tool --
05:27:06 21 I apologize.

05:27:16 22 The resolution of the pressure gauge in the MDT tool
05:27:19 23 that was used at the Macondo before the explosion was .02 psi;
05:27:24 24 isn't that correct?

05:27:24 25 A. Correct.

05:27:25 1 Q. Let's call up TREX-011696R.N.28.1.US.

05:27:37 2 Dr. Gringarten, this is a figure from your report
05:27:40 3 showing the MDT pressure measurement for the M56D layer; isn't
05:27:44 4 that correct?

05:27:45 5 A. That's correct.

05:27:45 6 Q. And the yellow highlighting represents a range of .02 psi
05:27:51 7 pressure measurements; isn't that correct?

05:27:52 8 A. Yes.

05:27:52 9 Q. And isn't it true that for this layer, at least, virtually
05:27:56 10 all of the pressure changes that you analyzed fell within the
05:28:00 11 resolution of the gauge?

05:28:01 12 A. No. Because what you didn't show is the -- you know, the
05:28:06 13 pressure at the beginning of the buildup. What is important is
05:28:11 14 the ratio between the -- this is not a signal. That's a
05:28:16 15 resolution of the signal. And what you are showing -- what is
05:28:18 16 important is the ratio of the signal to the noise, which is the
05:28:23 17 resolution. And, you know, we are measuring the Delta P. The
05:28:28 18 Delta P is not shown here.

05:28:30 19 Q. You are determining a trend of data, the trend of this
05:28:35 20 data, correct, that's what the green line and the red line
05:28:38 21 represent?

05:28:38 22 A. That's right. That's to see what would be the range of
05:28:41 23 possibilities. I have analyzed the actual data and I have
05:28:47 24 produced the Delta P, which we don't see here.

05:28:51 25 Q. But it is true that you are trying to determine whether

05:28:53 1 these measurements have a trend in them, correct?

05:28:56 2 A. That's correct. And the trend is being used for obtaining
05:29:00 3 a range of possibility, you know, because we have uncertainty
05:29:05 4 due to the resolution of the gauge. But what we are analyzing
05:29:08 5 is not -- you know, that yellow part, it's the, you know,
05:29:13 6 Delta P from the moment of the shut-in to the resolution, so
05:29:18 7 that's the signal.

05:29:19 8 Q. And you are trying to determine whether these points make
05:29:24 9 a line that goes up or a line that goes down. So you're trying
05:29:27 10 to determine what trends you can get from these different
05:29:31 11 points?

05:29:31 12 A. That's correct.

05:29:31 13 Q. And the measurement of these different points all fall
05:29:35 14 within the resolution of the gauge?

05:29:38 15 A. But that's not the signal. The signal is a Delta P, and
05:29:43 16 so it's a difference between the pressure at the time you do
05:29:46 17 the shut-in and the pressure of during the shut-in, so this is
05:29:53 18 really not representing what we are analyzing.

05:29:55 19 Q. For the permeability, do you not get your estimate from
05:29:58 20 this time period?

05:29:59 21 A. No.

05:30:00 22 Q. You do not use these -- mean trend and average trend to
05:30:06 23 obtain your estimate of permeability?

05:30:06 24 A. No. I use the Delta P. As I said, I use the difference
05:30:10 25 between the pressure at the time of shut-in and the pressure

05:30:14 1 during the shut-in and that's what everybody does.

05:30:17 2 And this, what you're showing me here, is -- would
05:30:21 3 be, in fact, the analysis where we only rely on, let's say, the
05:30:25 4 Horner plot, as we said before, which is highly imprecise.

05:30:30 5 Q. You agree that the data -- the resolution of this gauge
05:30:34 6 introduces at least some uncertainty into your analysis?

05:30:38 7 A. Yes.

05:30:38 8 Q. And you would agree that the pressure changes during the
05:30:43 9 time period shown on this graph all fall within the resolution
05:30:46 10 of the gauge?

05:30:46 11 A. No.

05:30:46 12 Q. During the time period that's shown on this graph?

05:30:50 13 A. No. That's not the change in pressure. The change in the
05:30:53 14 pressure is the difference from the pressure at the time of
05:30:57 15 shut-in.

05:30:58 16 Q. Sir, each of these points that is connected by the black
05:31:01 17 line is a pressure measurement, correct?

05:31:02 18 A. Yes.

05:31:03 19 Q. And these are pressure measurements plotted against time;
05:31:08 20 isn't that correct?

05:31:08 21 A. Yes. But that's not the signal. The signal is the
05:31:11 22 difference in pressure between the pressure during the shut-in
05:31:15 23 and the pressure at the beginning of the shut-in.

05:31:18 24 Q. I'm asking you a different question than you're answering,
05:31:21 25 so let me try and make it clear again.

05:31:23 1 You attest in your red line and your green line to
05:31:28 2 determine a trend in this data, correct?

05:31:30 3 A. Correct.

05:31:30 4 Q. And this data that you are trying to find a trend in, all
05:31:36 5 of the changes in the data during this time period occur within
05:31:40 6 the resolution of the gauge?

05:31:42 7 A. That's the reason why, you know, I tried to determine what
05:31:46 8 would be the possible trend -- trends given the uncertainty of
05:31:50 9 the data. But as I repeat, that's not the signal I'm
05:31:54 10 analyzing.

05:31:54 11 Q. Now, you did an analysis of this data to come up with two
05:32:01 12 estimates of permeability for the M56D layer, correct?

05:32:05 13 A. Correct.

05:32:05 14 Q. And those two analyses you called your main trend and your
05:32:10 15 average trend, correct?

05:32:11 16 A. Yes.

05:32:11 17 Q. And the value that you got for your average trend when you
05:32:16 18 did a detailed analysis of the permeability was
05:32:22 19 292 millidarcies; isn't that correct?

05:32:24 20 A. Correct.

05:32:24 21 Q. Then after you had also done your main trend analysis and
05:32:28 22 come up with a value of 110 millidarcies, you ran a Monte Carlo
05:32:33 23 analysis, correct?

05:32:33 24 A. Right.

05:32:34 25 Q. Let's call up TREX-011696-R.113.1.US. This is Table 10.

05:32:47 1 Do you need me to say that again? I do need to say
05:32:52 2 it again.

05:32:53 3 Well, before we get there, you stated in your report
05:32:56 4 that you considered your result from the average trend to be a
05:33:00 5 reasonable upper bound for your permeability, didn't you?

05:33:05 6 A. I'm sorry. Could you repeat that.

05:33:06 7 Q. You stated in your report that the 292 millidarcy estimate
05:33:12 8 that you obtained for the average trend was a reasonable upper
05:33:16 9 bound for your permeability estimate, did you not?

05:33:19 10 A. Yes.

05:33:19 11 Q. Now let's go to TREX-011696-R.0113.1.US.

05:33:35 12 And this is Table 10 from your attempt at analyzing
05:33:39 13 the MDT data, correct?

05:33:43 14 A. Yes.

05:33:43 15 Q. We see here on the column labeled M56D, parentheses, 144,
05:33:47 16 we see that your P0 value is 281.9, correct?

05:33:53 17 A. Yes.

05:33:54 18 Q. And the P0 value represents a conclusion that there is a
05:33:59 19 0 percent probability that your permeability value will be
05:34:02 20 greater than 281.9; isn't that correct?

05:34:05 21 A. Yes.

05:34:06 22 Q. And yet you had already identified a reasonable upper
05:34:09 23 bound at 292, correct?

05:34:11 24 A. Well, this was an upper bound. That's not how the
05:34:16 25 uncertainty is calculated. What you calculate -- as I said in

05:34:33 1 my report, you calculate -- what you obtain from the analysis
05:34:38 2 are, you know, dimensions, numbers. And in this particular
05:34:44 3 case, you get a range of dimensions and parameters or --
05:34:51 4 dimensions and parameters, which are -- for instance, here is a
05:34:54 5 pressure match.

05:34:55 6 And so we do -- you know, we get a different pressure
05:34:57 7 match for -- you know, for the two bands to, you know, cover
05:35:05 8 the range of points. And you go from the Monte Carlo analysis
05:35:14 9 on this numbers, thinking there are other numbers, and what you
05:35:19 10 end up with is the distribution I've expressed here.

05:35:22 11 Q. And, sir, again, my question, I think, was a simple one.
05:35:26 12 Your Monte Carlo analysis assigns a P0 value to
05:35:31 13 281.9 millidarcies, correct?

05:35:31 14 A. Yes.

05:35:31 15 Q. And you had already calculated an average trend
05:35:36 16 permeability as a reasonable upper bound of 292 millidarcies;
05:35:41 17 isn't that correct?

05:35:41 18 A. Yes. And --

05:35:43 19 Q. That was all I was asking, sir.

05:35:44 20 Let's go on to another question I have about your
05:35:48 21 permeability analysis.

05:35:50 22 You agree that the Macondo reservoir is a high
05:35:53 23 mobility reservoir, don't you?

05:35:58 24 A. What do you call a *high mobility*?

05:36:00 25 Q. Well, let me define for the judge in case he hasn't heard

05:36:04 1 this term yet. I don't believe he has.

05:36:06 2 Mobility is a measure of the permeability over the
05:36:10 3 viscosity of the reservoir fluid; isn't that correct?

05:36:13 4 A. Yes.

05:36:14 5 Q. And permeability is measured in millidarcy, correct?

05:36:20 6 A. Permeability is measured in millidarcy, yes.

05:36:22 7 Q. And viscosity is measured in centipoise, correct?

05:36:25 8 A. Yes.

05:36:26 9 Q. And a reservoir of several hundred to over a thousand
05:36:32 10 millidarcy per centipoise would be a high mobility reservoir;
05:36:32 11 would it not?

05:36:37 12 A. Yes.

05:36:37 13 Q. And it's true that if we used even your permeability value
05:36:42 14 of 238, given that you used a viscosity or mu of .205 to .249
05:36:50 15 that the ratio of 238 to .249 is roughly 1,161?

05:36:56 16 A. Yes.

05:36:59 17 Q. So the Macondo reservoir is a high mobility reservoir,
05:36:59 18 correct?

05:37:04 19 A. Yes.

05:37:05 20 Q. Okay. Now, the judge saw this earlier with a different
05:37:10 21 TREX number, but I'm going to call it up with the US's
05:37:14 22 TREX number. Let's call up TREX-011697, please.

05:37:22 23 This is the paper that you referenced earlier in your
05:37:24 24 testimony with your counsel, correct?

05:37:25 25 A. Yes.

05:37:26 1 Q. And it's a discussion of wireline formation tests,
05:37:30 2 including MDT tests, correct?

05:37:33 3 A. Sorry. Could you repeat that.

05:37:34 4 Q. It's a discussion of the use of MDT tests and other
05:37:38 5 wireline formation tests, correct?

05:37:40 6 A. Yeah. Except the difference here is we were talking in
05:37:45 7 this paper about a pretest. You know, as -- I may not have
05:37:50 8 explained to you, Judge -- there are two types of use of the
05:37:57 9 wireline formation tool. One is used where you lower the tool
05:38:06 10 at different levels in the reservoir and then you do what we
05:38:09 11 call a pretest, which you pick -- withdraw 22 cubic centimeter
05:38:17 12 of fluid, and you measure the pressure. And the purpose of
05:38:20 13 that is to calculate the initial pressure at that point in the
05:38:25 14 reservoir. And you do several stations, and you keep repeating
05:38:29 15 it.

05:38:30 16 And so that's what we were talking about in this
05:38:32 17 paper. What I've used for the MDT analysis is a sample test
05:38:39 18 where we do have these pretests, but we are also pumping for
05:38:45 19 several hours. And so that becomes equivalent, *de facto* to a
05:38:52 20 normal well test because instead of it being a radius of
05:38:58 21 investigation of a few feet, we now have a radius of
05:39:02 22 investigation which is a distance of where the pressure has
05:39:06 23 gone of about 600 feet, which is a significant portion of the
05:39:10 24 reservoir, and therefore, we get -- you know, we are in a
05:39:14 25 condition of a normal test.

05:39:15 1 Q. Your radius of investigation, even using deconvolution, is
05:39:21 2 657 feet roughly?

05:39:22 3 A. Yes.

05:39:22 4 Q. And the reservoir is 10,000 feet long; is it not?

05:39:25 5 A. But it is about 1200 feet large, you know, of the distance
05:39:31 6 of the well, is about. So it's 2400 feet roughly. I don't
05:39:35 7 remember exactly the numbers, but -- and so this is a
05:39:40 8 significant portion.

05:39:41 9 Q. In this article that's up on the screen, you caution that
05:39:47 10 in using the pretests, the withdrawal of 20 cc's of fluid, you
05:39:53 11 may have unreliable results if you are working in a high
05:39:58 12 permeability reservoir; isn't that correct?

05:39:58 13 A. I'm not sure we mentioned that in those words.

05:40:04 14 Q. Well --

05:40:06 15 A. But what is important, as I said before, is a signal to
05:40:10 16 those ratio.

05:40:10 17 Q. Let's go to page -- TREX-011697.0004, please, and go to
05:40:25 18 the conclusion section. And -- yes.

05:40:30 19 In the second bullet there, it says, "In lower
05:40:34 20 permeability reservoirs, mobility is less than about
05:40:39 21 100 millidarcies per centipoise. The quality of data recorded
05:40:42 22 by wireline formation test tools is suitable for pressure
05:40:46 23 transient interpretation.

05:40:47 24 "In higher permeability, the resolution of the
05:40:49 25 pressure gauge limits the quality of the data often precluding

05:40:53 1 transient analysis, and the FRA method then provides the best
05:40:58 2 estimate of mobility."

05:41:01 3 That is what you said in your article regarding
05:41:03 4 pretests; isn't that correct?

05:41:04 5 A. Yes. It says "often precluding." And again, we are
05:41:07 6 talking about the pretest. We are in totally different
05:41:11 7 situation here. We have sampling and so we have pumped for
05:41:17 8 many hours, and so we have all the tools to do the analysis.

05:41:20 9 Q. You have had a sampling run and then the reservoir has
05:41:23 10 returned to near initial conditions, and then you have a
05:41:26 11 withdrawal, just like these pretests, of 20 cc's of fluid;
05:41:29 12 isn't that correct?

05:41:30 13 A. Yes. But --

05:41:32 14 Q. Yes.

05:41:34 15 A. No. The buildup benefits from the production before, and
05:41:37 16 so you cannot isolate and, you know, say that the pretest is
05:41:41 17 equivalent to a pretest in the beginning. That is totally
05:41:44 18 wrong.

05:41:44 19 Q. I did not ask you to say that. I asked you, you had
05:41:47 20 several hours of sampling, then the reservoir returned to near
05:41:52 21 initial conditions and then you withdrew 20 cc's of fluid in a
05:41:57 22 pretest; isn't that correct?

05:41:58 23 A. I don't think the pressure went back to the initial
05:42:02 24 conditions.

05:42:02 25 Q. It went back to near initial conditions; isn't that

05:42:04 1

correct?

05:42:04 2

A. Well, what do you call *near*? I don't think. Since we

05:42:06 3

have to extrapolate and calculate and use a model to get to the

05:42:10 4

initial pressure, and we didn't, you know, really get back to

05:42:12 5

the initial pressure.

05:42:13 6

Q. So your estimate of initial pressure is a calculation

05:42:19 7

based on the MDT data; is that correct?

05:42:22 8

A. Yes.

05:42:22 9

Q. Now, you only performed a detailed analysis of the

05:42:32 10

flow rate pretest; isn't that correct?

05:42:35 11

A. Yes. But I used all the buildups to verify the

05:42:41 12

analysis -- consistency of the analysis. And the other tests

05:42:44 13

that I ranked were shorter. So I used a series of, you know,

05:42:50 14

standard techniques, which is comparing all the buildups

05:42:53 15

together using deconvolution, and that's how you gain

05:42:58 16

confidence in the analysis.

05:42:59 17

Q. Now, you indicated that the reason that you didn't do a

05:43:02 18

detailed analysis of the other buildups was because in

05:43:08 19

Figure 27 and 28 of your report, you showed that the high rate

05:43:15 20

buildups would give you the same permeability model; isn't that

05:43:15 21

correct?

05:43:18 22

A. Yes.

05:43:18 23

Q. And a permeability model is different than a permeability

05:43:22 24

value; isn't that correct?

05:43:27 25

A. Okay. I'm not sure I used the word *permeability model*.

05:43:30 1 Q. Okay. Let's go ahead and call up your deposition.
05:43:34 2 Deposition at 82, line 20 to 83, line 6.

05:43:42 3 So I start at line 20 and I ask you: "Is there any
05:43:44 4 other reason why you excluded the other buildups, other than
05:43:47 5 the final pretests, from your calculation of permeability?"

05:43:51 6 And you ask me: "Other than what?"

05:43:53 7 And I say: "Other than the analysis that you've
05:43:56 8 discussed in Figures 27 and 28."

05:43:59 9 And we continue on to the next page and after another
05:44:02 10 objection, we see: "No. Figure 28 show that the same model
05:44:07 11 will apply to, you know, all the buildups, and so there is no
05:44:12 12 point in redoing the analysis for each individual buildup
05:44:15 13 since, you know, clearly, they give the same model."

05:44:18 14 Did I ask you those questions and did you give those
05:44:21 15 answers?

05:44:22 16 A. Yeah. And, you know, those answers are, you know, still
05:44:26 17 valid. I don't see *permeability model* mentioned anywhere here.

05:44:31 18 Q. Well, you said *model*. They give you the same model.

05:44:34 19 A. Okay. But --

05:44:35 20 Q. And is a model the same as a value?

05:44:37 21 A. No.

05:44:38 22 Q. And I want to look at -- a little bit closer at Figures 27
05:44:43 23 and 28. Let's begin with TREX-011696-R-N.104.01.US.

05:44:56 24 And this is Figure 28 from your report; is that
05:44:58 25 correct?

05:44:58 1 A. That's correct.

05:44:58 2 Q. And if you could indulge me and make that bigger, just a
05:45:02 3 little bit larger. No. You were on the right one the first
05:45:05 4 time. You're stealing my thunder here. You could increase the
05:45:10 5 graph a little bit. Thank you.

05:45:12 6 Now, this blue box here is what you call in your
05:45:16 7 report your area of radial flow uncertainty, correct?

05:45:23 8 A. Correct.

05:45:23 9 Q. And that means that this is where you -- this is the part
05:45:27 10 of the buildup that you were going analyze in order to get your
05:45:31 11 permeability value, correct?

05:45:32 12 A. That's correct.

05:45:33 13 Q. And you get your permeability value by taking a particular
05:45:36 14 buildup. Let's pick the blue one. These data points are the
05:45:40 15 buildup, are one buildup, correct?

05:45:43 16 A. Yeah. Except I certainly would not use the blue one,
05:45:47 17 because as you can see, it's of limited length. It goes to
05:45:52 18 .1 second, and so I would use the black one. And most
05:45:55 19 likely -- that's most likely what I've used.

05:45:58 20 Q. That's the pretest, is the black?

05:46:01 21 A. No, the black is not the pretest. Okay, maybe. I don't
05:46:04 22 know.

05:46:04 23 Q. And then there is another buildup that's this red one?

05:46:08 24 A. Yes.

05:46:08 25 Q. And there is another buildup that's yellow, correct?

05:46:10 1 A. And the point of this plot is that, you know, we plot
05:46:23 2 Delta Q over pressure. It's a change in pressure from the
05:46:29 3 beginning of the buildup divided by the rate, you know, before
05:46:33 4 that buildup.

05:46:33 5 And so what that plot shows is that they all
05:46:39 6 stabilize at the same level. They get essentially the same --
05:46:43 7 they correspond to essentially the same model with some
05:46:48 8 variation in parameters, and the band in blue, which is a
05:46:54 9 radial flow uncertainty, is what we used for the uncertainty
05:46:58 10 analysis in the calculation and the evaluation of the
05:47:02 11 uncertainty and the permeability.

05:47:03 12 Q. You would agree with me, would you not, that that
05:47:07 13 uncertainty band is one log cycle high?

05:47:10 14 A. Yes.

05:47:13 15 Q. Okay.

05:47:13 16 A. About, yes.

05:47:14 17 Q. And you would agree with me that the way that you would
05:47:16 18 find permeability from one of these buildups is by finding the
05:47:19 19 appropriate trend line of the data in this blue box area?

05:47:25 20 A. It's my drawing, you know, by different means, either by
05:47:29 21 hand or through nonlinear regression, there is a horizontal
05:47:41 22 line through the data.

05:47:42 23 Q. And if you chose a model that was at the top of this box,
05:47:45 24 and then a model that was at the bottom of this box, it would
05:47:49 25 have the same shape, but the value of permeability would differ

05:47:52 1 by an order of ten; isn't that correct?

05:47:55 2 A. Not quite ten.

05:47:57 3 Q. But close to ten?

05:47:59 4 A. About two. Because clearly, there are some points that
05:48:04 5 are -- you know, that are noise. And so, therefore, here I
05:48:09 6 would, and I probably did, take a factor two or three.

05:48:12 7 Q. Two or three times different?

05:48:15 8 A. Yes. And that's used for the uncertainty analysis.

05:48:21 9 Q. Okay. Let's talk now about some quick facts that I want
05:48:24 10 to confirm, and then I'll have one more area after that and
05:48:27 11 you'll be done with me, Dr. Gringarten.

05:48:29 12 A. Thank you.

05:48:30 13 Q. I don't know if I should be insulted by that, sir.

05:48:34 14 I just want to confirm some quick facts. The thicker
05:48:37 15 layers of the reservoir will have more weight in the average
05:48:41 16 permeability that you calculated; isn't that correct?

05:48:43 17 A. That's correct.

05:48:43 18 Q. And the thickest zone that you analyzed with MDT data in
05:48:49 19 this case was the M56E Lower Layer; isn't that true?

05:48:52 20 A. That's correct.

05:48:52 21 Q. And so, therefore, the M56E Lower Layer would have the
05:48:56 22 largest influence on your average permeability; isn't that
05:48:58 23 correct?

05:48:58 24 A. Yes. I think it was -- I don't remember, sorry, the
05:49:03 25 numbers, 60 feet to 40 feet.

05:49:06 1 Q. It's on that order?

05:49:08 2 A. Yes.

05:49:08 3 Q. I'm not going to ask you for the numbers, don't worry.

05:49:10 4 A. And the others are, you know, about 20, so we are talking
05:49:14 5 about, you know, 60 to 40. So the other two layers, the
05:49:20 6 E upper and D will still have an inference, which is, you know,
05:49:27 7 very close, you know, 40 to 60, the inference would be almost
05:49:34 8 similar.

05:49:34 9 Q. But individually, the M56E layer as compared to either the
05:49:42 10 M56E upper or the M56D will have a greater influence?

05:49:46 11 A. Yeah. But you have to look at all of that together.

05:49:49 12 Q. Yes. But if you have an error in your M56E Lower Layer
05:49:51 13 and you have underestimated the permeability for that layer, it
05:49:55 14 will have a larger impact on your average permeability than if
05:49:59 15 you had an error in your M56E Upper Layer; isn't that correct?

05:50:03 16 A. Could you repeat. Sorry.

05:50:09 17 Q. Yeah. It was probably a little convoluted.

05:50:15 18 If you have underestimated the permeability for the
05:50:17 19 M56E Lower Layer, that would have a greater impact your average
05:50:22 20 permeability than if you had underestimated the value of the
05:50:26 21 permeability for the M56E Upper Layer, isn't that true?

05:50:29 22 A. Well, you would have, you know, an inference within the
05:50:34 23 ratio of 60 to 40.

05:50:36 24 Q. Would it be 60 to 40 comparing the M56E Lower to the
05:50:42 25 M56E Upper?

05:50:42 1 A. Yeah. But you don't compare the two. You have three
05:50:46 2 layers. That's what you have to take into account.

05:50:49 3 Q. You agree that the M56F layer is only 6.5 feet thick,
05:50:53 4 correct?

05:50:54 5 A. That's correct.

05:50:54 6 Q. And, in your opinion, the M56F layer did not have a
05:50:58 7 significant influence on your overall thickness based average;
05:50:58 8 isn't that correct?

05:51:02 9 A. Yeah. It's the smallest influence of all the three
05:51:07 10 layers -- the four layers.

05:51:08 11 Q. And you agree that M56E Upper Layer has the lowest
05:51:13 12 permeability of the three layers that were analyzed using MDT
05:51:16 13 data?

05:51:17 14 A. Start again. Sorry.

05:51:18 15 Q. Probably the court reporter is grateful for your slowing
05:51:22 16 me down.

05:51:23 17 You agree, do you not, that the M56E Upper Layer has
05:51:27 18 the lowest permeability of the three layers analyzed by the MDT
05:51:32 19 tool?

05:51:33 20 A. Well, if I recall, the -- you know, the -- the most likely
05:51:37 21 probability are, you know, 116, 117, and 280 something.

05:51:44 22 Q. And you agree that the M56E Upper Layer has the lowest of
05:51:49 23 the three?

05:51:51 24 A. Well, if you say 116 is less than 117, you're right. But
05:51:58 25 I would call them, you know, very similar.

05:52:00 1 Q. Let's wrap up by talking about an estimate of permeability
05:52:06 2 that was performed by BP during the response.

05:52:08 3 As part of its efforts to characterize the reservoir
05:52:11 4 for purposes of stopping the spill after the explosion, BP had
05:52:16 5 its internal experts prepare an estimate of the permeability of
05:52:20 6 the reservoir in July of 2010; did it not?

05:52:23 7 A. Yes.

05:52:23 8 Q. And let's call up TREX-003533.

05:52:31 9 And this is that analysis, correct?

05:52:35 10 A. Okay.

05:52:35 11 Q. Do you agree?

05:52:37 12 A. Yes. I have difficulty reading it.

05:52:41 13 Q. We can call that out for you.

05:52:46 14 A. Okay. Good. All right. Yes.

05:52:46 15 Q. Okay. And now let's go to page 35 of this document. And
05:52:55 16 if we can call out the bullet at the top, *Mobility*. Yes, that
05:53:01 17 bullet.

05:53:01 18 And at the time of the response, from this bullet, we
05:53:04 19 can see that BP had available to it the MDT data, did it not?

05:53:08 20 A. Okay. Yes. And that's what we had found.

05:53:17 21 Q. And it states that mobility from the pretests confirm that
05:53:22 22 the sands have high permeability in the 100 millidarcies range,
05:53:29 23 correct?

05:53:29 24 MR. BOLES: Objection, Your Honor. Lack of foundation.
05:53:32 25 That's important because of the lack of permeability that we've

05:53:35 1 talked about with the witnesses.

05:53:36 2 MS. HIMMELHOCH: Your Honor, they questioned him on
05:53:38 3 direct regarding what use other experts had made of the MDT
05:53:42 4 data.

05:53:42 5 THE COURT: I overrule the objection.

05:53:42 6 EXAMINATION BY MS. HIMMELHOCH:

05:53:44 7 Q. This is what they stated with respect to the MDT data;
05:53:47 8 isn't that correct?

05:53:47 9 A. Well, that's what written here, yes.

05:53:49 10 Q. And on page 13, if we go to TREX-003533, and call out the
05:53:57 11 first paragraph of the summary.

05:53:59 12 "Having looked at the data, including some of the MDT
05:54:04 13 data, BP concluded, using its internal experts during a
05:54:08 14 response, that the range of permeability averages for this
05:54:11 15 reservoir were between 250 and 500 millidarcies"; isn't that
05:54:16 16 correct?

05:54:19 17 A. Where do I read?

05:54:19 18 Q. It's the second to last line.

05:54:21 19 A. Yeah, I see the last line. I'm trying to look, you know,
05:54:24 20 what is before.

05:54:27 21 Q. I'm not suggesting that it was calculated from MDT data.
05:54:31 22 I'm simply asking to you confirm that knowing that there was
05:54:34 23 MDT data, BP chose to calculate its estimate of the
05:54:39 24 permeability as 250 to 500 millidarcies during the response;
05:54:43 25 isn't that correct?

05:54:43 1 A. Well, that doesn't seem -- you know, I may be missing
05:54:47 2 something here, because if I read the next line, it says,
05:54:50 3 "Permeability was calculated using a post permeability
05:54:58 4 transformed based on sidewall core data analysis."

05:55:03 5 So I don't see any mention here of MDT.

05:55:05 6 Q. We are in the same document, do you agree, sir?

05:55:07 7 A. Yes.

05:55:08 8 Q. And the document on the prior page we were looking at, you
05:55:12 9 agree, showed that they were aware of the MDT data, correct?

05:55:15 10 A. Yes.

05:55:15 11 Q. And being aware of the MDT data, the internal experts at
05:55:20 12 BP chose a different method to the estimate the permeability
05:55:23 13 and concluded that the permeability range was between 250 and
05:55:26 14 500 millidarcy; isn't that correct?

05:55:29 15 MR. BOLES: I object, lack of foundation for his
05:55:31 16 knowledge about any other BP expert or witness these numbers
05:55:35 17 refer to.

05:55:35 18 THE COURT: I overrule the objection.

05:55:35 19 BY MS. HIMMELHOCH:

05:55:39 20 Q. Do I need to repeat the question, sir?

05:55:42 21 A. Yes.

05:55:43 22 Q. Aware that the MDT data existed, BP's internal experts
05:55:49 23 chose to use a different methodology to calculate permeability,
05:55:51 24 and the conclusion that they drew during the response was that
05:55:54 25 the permeability averages in the range of 250 to 500

05:55:59 1 millidarcy; isn't that correct?

05:56:01 2 A. Well, that's -- they say arithmetic, and that puzzles me,
05:56:06 3 and log derived. So also they mentioned MDT at the beginning.
05:56:12 4 They don't give anything special about MDT.

05:56:17 5 What they refer to here is log derived permeability
05:56:21 6 they are using opposed to permeability transformed, so I don't
05:56:25 7 see the connection between the two.

05:56:28 8 Q. Sir, you agree that at the time that they wrote this
05:56:31 9 paragraph, because this paragraph is in the same document as
05:56:34 10 the previous paragraph we looked at, these internal experts
05:56:37 11 were aware of the MDT data, correct?

05:56:40 12 A. You know, they seemed to be aware.

05:56:42 13 Q. They chose a different method to estimate the
05:56:46 14 permeability, and using that different method they concluded
05:56:49 15 that the permeability averages in the range of 250 to 500
05:56:54 16 millidarcy; isn't that correct?

05:56:55 17 A. That's correct, but I have --

05:56:59 18 MS. HIMMELHOCH: Thank you. I have no further
05:57:00 19 questions.

05:57:04 20 THE COURT: Redirect.

05:57:13 21 MR. BOLES: Yes, please, Your Honor.

05:57:13 22 REDIRECT EXAMINATION BY MR. BOLES:

05:57:31 23 Q. Let's start where you just left off, Dr. Gringarten, that
05:57:36 24 BP technical memorandum, TREX-3533, that Counsel characterized
05:57:45 25 as showing that BP's internal experts characterized the

05:57:50 1 permeability as 250 to 500 millidarcies. Do you remember that
05:57:55 2 line of questions you were just asked?

05:57:56 3 A. Yes.

05:57:58 4 Q. Do you know, Dr. Gringarten, whether that number was
05:58:00 5 actually used by BP modelers in that range that's reported?

05:58:05 6 A. No, I don't.

05:58:05 7 Q. Have you read the expert report of Dr. Kelkar?

05:58:09 8 A. Yes.

05:58:12 9 Q. Does Dr. Kelkar take the same permeability numbers that
05:58:15 10 are reported in that memorandum and come up with a number of
05:58:19 11 300 millidarcies for his PI calculation in his expert report?

05:58:24 12 MS. HIMMELHOCH: Objection, beyond the scope of
05:58:26 13 Dr. Gringarten's report.

05:58:29 14 THE COURT: Overruled.

05:58:31 15 THE WITNESS: Yes.

05:58:31 16 BY MR. BOLES:

05:58:33 17 Q. Dr. Gringarten, do you know whether BP's internal
05:58:38 18 reservoir modelers took the number that was referred to that we
05:58:43 19 just saw in TREX-3533, and applied a scaling factor to go from
05:58:49 20 those air permeability numbers to an effective permeability to
05:58:53 21 oil that they actually used in modeling to characterize a
05:58:58 22 reservoir?

05:58:59 23 MS. HIMMELHOCH: Objection. Leading, lack of
05:59:00 24 foundation.

05:59:01 25 MR. BOLES: The whole line of questioning is lack of

05:59:03 1 foundation, Your Honor.

05:59:04 2 THE COURT: Overruled.

05:59:05 3 THE WITNESS: If I recall, it was done by the oil
05:59:10 4 saturation, which was 0.87.

05:59:20 5 BY MR. BOLES:

05:59:20 6 Q. Dr. Gringarten, do you -- you were shown a graph,
05:59:26 7 Figure 27 from your report, showing the radial flow
05:59:31 8 stabilization plots on page 23 of your expert report, do you
05:59:34 9 remember that?

05:59:35 10 A. Yes.

05:59:37 11 Q. Is that kind of data and variability in the data something
05:59:43 12 that you see on a regular basis in your well test analysis work
05:59:48 13 that you -- where you interpret data to give your oil industry
05:59:52 14 clients a permeability number?

05:59:53 15 A. Yes.

05:59:54 16 Q. Did you apply standard methods to deal with the noisiness
05:59:59 17 in the data?

06:00:00 18 A. Yes.

06:00:00 19 Q. You were asked on cross about the P0 permeability of
06:00:14 20 281 millidarcies and an upper bound of 292 millidarcies, do you
06:00:18 21 remember that?

06:00:18 22 A. Yes.

06:00:19 23 Q. I think you were about to say something else in your
06:00:22 24 answer. Do you have something you want to add to that?

06:00:24 25 A. I'm not sure I recall what I wanted to say.

06:00:28 1 Q. This is when you were talking about the P0 permeability of
06:00:31 2 281 and an upper bound of 292. You had started to give an
06:00:38 3 answer, and I think you might have been cut off.

06:00:39 4 A. Well, what I was explaining is how the uncertainty is
06:00:45 5 calculated. What we get from the match is not the permeability
06:00:51 6 directly, but a number which has permeability in it.

06:00:56 7 What we input into the -- calculation is the upper
06:01:02 8 limit of that number, which includes permeability, viscosity,
06:01:07 9 rate and so forth. Then we do a Monte-Carlo on the error
06:01:12 10 uncertainty on every member of the number, and including the
06:01:18 11 quality of the match.

06:01:19 12 That is what is giving the probability distribution
06:01:23 13 on every parameter, including the permeability.

06:01:26 14 Q. Dr. Gringarten, you were also shown your article about the
06:01:32 15 use of wireline tools for well test analysis, do you recall
06:01:37 16 that?

06:01:37 17 A. That's correct.

06:01:37 18 Q. That article discussing some potential limitations or
06:01:43 19 precautions that need to be used in using those kind of tools
06:01:47 20 for well test analysis?

06:01:48 21 A. Yes.

06:01:49 22 Q. Do those limitations apply or limit the reliability of the
06:01:54 23 analysis you've done in this case?

06:01:54 24 A. No.

06:01:55 25 Q. Why not?

06:01:56 1 A. Because, as I explained, we are analyzing sampling tests,
06:02:03 2 and so -- which has four hours, three to four hours of sampling
06:02:10 3 before.

06:02:10 4 So the final build-up or the build-ups that I have
06:02:14 5 analyzed benefit from that extended production time, sampling
06:02:22 6 time, which, you know, extend the radius of investigation.

06:02:26 7 So we are in, as I say, the condition of the normal
06:02:29 8 test. If we had run a DST, which is, you know, the test that
06:02:34 9 you -- between packers that are attached to the drilling pipes,
06:02:40 10 which is a typical test we do once a well has been completed,
06:02:46 11 then we would reach about the same radius of investigation.

06:02:49 12 So with the sampling test -- with the -- yeah,
06:02:55 13 sampling test, we are essentially in the condition of a real
06:02:59 14 test.

06:02:59 15 Q. Now, those pumping tests that you're referring to now, is
06:03:03 16 that what you --

06:03:03 17 A. Sampling tests.

06:03:04 18 Q. -- sampling tests, is that what you looked at in your
06:03:07 19 analysis from the MDT tool to calculate permeability at
06:03:12 20 Macondo?

06:03:12 21 A. That's correct.

06:03:13 22 Q. How long is -- what's the comparison of the pumping
06:03:17 23 duration and the resulting radius of investigation of those
06:03:23 24 sampling tests as opposed to these pretests being described in
06:03:27 25 your article?

06:03:28 1 A. If you don't use deconvolution, the radius of
06:03:35 2 investigation, which is the distance which on the pressure
06:03:37 3 signal in the pretest, including the last one, would be
06:03:40 4 60 feet, so we have reached ten times the distance that we
06:03:47 5 would have reached by analyzing -- you know, not taking -- you
06:03:50 6 know, analyzing just the pretest.

06:03:52 7 Q. On direct, Dr. Gringarten, you were asked whether PT-B
06:03:57 8 pressures can be used reliably in calculating cumulative flow.
06:04:02 9 Do you remember that?

06:04:03 10 A. Yes.

06:04:03 11 Q. And do you think that any of the other experts in this
06:04:06 12 case who have used PT-B pressures have used that data reliably
06:04:11 13 in calculating cumulative flow?

06:04:14 14 MS. HIMMELHOCH: Objection, goes beyond the four
06:04:17 15 corners to the extent that they are inquiring about anybody
06:04:19 16 other than Dr. Kelkar and Dr. Pooladi-Darvish.

06:04:22 17 MR. BOLES: Well, presumably counsel's question is
06:04:26 18 going beyond just Dr. Gringarten's analysis, so she's opened
06:04:29 19 the door to this line of inquiry.

06:04:30 20 MS. HIMMELHOCH: I did not ask him to opine on the
06:04:34 21 propriety of Dr. Griffiths' use of the data. He testified in
06:04:36 22 his deposition that he had not read the report of
06:04:40 23 Dr. Griffiths. I think it's inappropriate and beyond the four
06:04:43 24 corners of his report to ask him to opine now as to
06:04:47 25 Dr. Griffiths' use of MDT.

06:04:50 1 MR. BOLES: I'll withdraw the question if we'll agree
06:04:50 2 on stipulating that Dr. Gringarten's answer on PT-B pressures
06:04:52 3 being used reliably was only referring to his work.

06:04:55 4 MS. HIMMELHOCH: I am not so stipulating, but I did not
06:04:59 5 ask him to opine on the propriety of its use in a particular
06:05:01 6 methodology.

06:05:01 7 THE COURT: Okay, you've won, Ms. Himmelhoch. Don't
06:05:03 8 keep going, I may change my mind.

06:05:06 9 MS. HIMMELHOCH: I've learned my lesson, sir.

06:05:06 10 BY MR. BOLES:

06:05:10 11 Q. Maybe I could ask this, Dr. Gringarten. Why is it that
06:05:13 12 you think the work you have done using PT-B pressures is a
06:05:17 13 reliable way of calculating cumulative flow?

06:05:22 14 A. Well, because I use deconvolution. Again, it's reliable
06:05:26 15 within the uncertainties, which I have described.

06:05:30 16 Q. When you mention deconvolution, I think that counsel asked
06:05:34 17 you some questions about how you use deconvolution to convert
06:05:41 18 the pressures measured at the PT gauge at the wellhead down to
06:05:47 19 reservoir pressures. Do you recall that?

06:05:48 20 A. Could you ask the question again? Sorry.

06:05:52 21 Q. Sure. The discussion about your Option 1 and your
06:05:56 22 Option 2 was a reference to the process you used to convert the
06:06:05 23 PT-B pressures, which were measured at the wellhead, down to
06:06:08 24 reservoir depth.

06:06:09 25 A. Yes.

06:06:10 1 Q. Why did you do that, Dr. Gringarten?

06:06:11 2 A. You mean why did I convert pressure from the surface to
06:06:17 3 the bottom?

06:06:19 4 Q. Right.

06:06:19 5 A. Because my experience -- and we have published a paper on
06:06:24 6 that -- is that the wellhead pressure does not fully represent
06:06:31 7 what's going on in the reservoir, you know, because of the
06:06:35 8 influence of the well --

06:06:37 9 In well tests, in normal well tests, the preferred
06:06:49 10 method is to have measurements at the bottom as well. So what
06:06:52 11 I was attempting here is to get back to the normal condition of
06:06:57 12 the test by converting the wellhead pressure into
06:07:02 13 bottomhole pressure.

06:07:03 14 Q. Now, it was mentioned in cross-examination that you did
06:07:05 15 that conversion. As one step of that conversion, you had to
06:07:09 16 provide estimated rates of flow to Dr. Johnson, so that he
06:07:15 17 could give you an input on the effects of pressure conversion
06:07:20 18 for multiphase flow and other complexities from the flow rate;
06:07:25 19 is that correct?

06:07:25 20 A. That's correct.

06:07:25 21 Q. You chose two different simplified assumed flow rates as a
06:07:34 22 starting point for your arriving at flow rates that you gave to
06:07:38 23 Dr. Johnson?

06:07:38 24 A. That's correct.

06:07:39 25 Q. Now, did the choice of those flow rates affect the

06:07:49 1 cumulative number that you've calculated and presented to this
06:07:53 2 Court?

06:07:55 3 A. Well, they do in the sense that the purpose of choosing
06:08:01 4 two initial flow rates is to end up with a range of pressure at
06:08:06 5 the bottom of the well. So it's a different process -- you
06:08:08 6 know, a separate process. We need to convert to the bottom of
06:08:12 7 the well, and for that then we need to have some assumption on
06:08:16 8 the rate. That's for just the purpose of conversion.

06:08:20 9 So I use a range of rates which give me a range of
06:08:23 10 pressure, you know, combined with a range of flow path. I take
06:08:29 11 that as -- you know, I end up with four cases that would
06:08:33 12 represent a reasonable range of expected bottomhole pressures.

06:08:38 13 Q. Let's just briefly discuss the two flow rates that you
06:08:44 14 began with in that process. One was assuming a constant
06:08:47 15 flow rate of 45,000 stock-tank barrels per day throughout the
06:08:52 16 incident, correct?

06:08:53 17 A. Yep.

06:08:53 18 Q. One started lower, at 30,000, and then jumped up to
06:08:59 19 45,000, correct?

06:08:59 20 A. That's correct.

06:08:59 21 Q. Which one of those two, Dr. Gringarten, the lower
06:09:06 22 flow rate assumption or the higher flow rate assumption,
06:09:09 23 results in a higher cumulative flow in your analysis?

06:09:13 24 A. The lower assumption.

06:09:15 25 Q. Why is that?

06:09:18 1 A. Well, because the higher the flow rate you start from, you
06:09:29 2 know, the higher the pressure drop because of friction. We are
06:09:33 3 talking about, you know, flowing now. If you start with a
06:09:37 4 higher rate, then you are going to calculate a higher pressure
06:09:43 5 drop between the top and the bottom.

06:09:47 6 Therefore, since the wellhead pressure is fixed, you
06:09:52 7 are going to come up with a higher bottomhole pressure. So
06:09:59 8 with a higher rate assumption at the beginning, you end up with
06:10:02 9 a lower pressure drop at the bottom from the initial pressure.
06:10:07 10 That then would give you a lower cumulative. So the higher you
06:10:14 11 start with, the lower cumulative you end up with.

06:10:17 12 Q. As a check on this process that you undertook to try to
06:10:23 13 convert PT-B pressures from the wellhead level down to
06:10:27 14 reservoir level, did you also check that against using the same
06:10:32 15 methodologies you described in your report, and just using the
06:10:37 16 raw unconverted PT-B pressure?

06:10:40 17 A. Yes. I did the same analysis on the wellhead pressure.
06:10:46 18 Using the wellhead pressure, then I calibrated the, you know,
06:10:52 19 rate to the most likely permeability of 238. That gave me a
06:11:00 20 cumulative of 2.7 million stock-tank barrel. So that's in
06:11:07 21 between the -- that's within the range I obtained by converting
06:11:11 22 to downhole.

06:11:12 23 Q. You were asked on direct about that first pressure that
06:11:17 24 you -- that's shown in your report, the pressure measurement
06:11:22 25 from the MDT tool of the Macondo Reservoir pressure on

06:11:25 1 April 12th. Do you remember that?

06:11:26 2 A. Yes.

06:11:27 3 Q. You were asked whether or not that was a flowing pressure.

06:11:31 4 Do you remember that?

06:11:31 5 A. Yes.

06:11:32 6 Q. Does that matter for the analysis you were doing?

06:11:34 7 A. No. You know, it's a static pressure.

06:11:43 8 Q. Is a static pressure appropriate for using in the analysis
06:11:47 9 you've done in the case?

06:11:47 10 A. Yes.

06:11:48 11 Q. You were asked also about the -- what you did with respect
06:11:52 12 to the gap in pressure data between that April 12th measurement
06:11:57 13 and May 8th when the PT-B started measuring pressure. Do you
06:12:02 14 recall that?

06:12:02 15 A. Yes.

06:12:03 16 Q. You were asked about the interpolation that you did
06:12:08 17 between the April 12th measurement and the May 8th measurement.
06:12:08 18 Do you recall that?

06:12:08 19 A. Yes.

06:12:12 20 Q. Now, sir, do you have an opinion as to whether -- on an
06:12:16 21 alternative approach, which would have been to ignore the
06:12:21 22 April 12th pressure reading and simply infer the pre-May 8th
06:12:23 23 pressure by extrapolating a trend line from the post-May 8th
06:12:28 24 PT-B pressure?

06:12:29 25 MS. HIMMELHOCH: Objection, beyond the four corners of

06:12:32 1 his report.

06:12:32 2 MR. BOLES: Well, he chose the method he did. He's
06:12:35 3 been questioned about it. I think we should ask him for his
06:12:39 4 opinions and reasons for doing it the way he did it.

06:12:44 5 THE COURT: I'll let him answer. Go ahead.

06:12:44 6 BY MR. BOLES:

06:12:58 7 Q. Did you understand my question?

06:13:01 8 A. Yes. So you said instead of using the initial pressure
06:13:05 9 obtained from the MDT, I would have extrapolated the trend --

06:13:09 10 Q. From post-May 8th back in time.

06:13:12 11 A. From post-May 8th back to Time Zero --

06:13:12 12 Q. Yes.

06:13:15 13 A. -- at the start of the spill. Well, that would be
06:13:17 14 improper.

06:13:17 15 Q. Why?

06:13:19 16 A. Because that's not the way it is.

06:13:20 17 Plus, if you do that, then you end up with a higher
06:13:23 18 rate, which would necessitate the Skin which would be very
06:13:29 19 negative and unphysical. So I don't think that would work.

06:13:33 20 Q. Dr. Gringarten, you were asked some questions about the
06:13:37 21 final flow rates at the end of the incident as shown on a
06:13:44 22 demonstrative showing some of the flow rates you've
06:13:46 23 reconstructed for this case. Do you recall that?

06:13:48 24 A. Yes.

06:13:48 25 Q. Now, when you take your relative flow rates from

06:13:54 1 deconvolution and then calibrate them through well test
06:13:59 2 analysis to the permeability you got from the MDT tool, does
06:14:04 3 that yield an estimate of final day flow rate?
06:14:07 4 A. Yes.
06:14:08 5 Q. Were those shown on those graphs?
06:14:11 6 A. Yes, when -- you know, the end part.
06:14:14 7 Q. Now, you were asked about Dr. Dykhuizen's final day flow
06:14:21 8 rate. I think counsel said it was 53,000 stock-tank barrels
06:14:25 9 per day. Do you remember that?
06:14:25 10 A. Yes.
06:14:26 11 Q. If you were to subtract a 20 percent uncertainty range
06:14:32 12 from 53,000 barrels per day, how would that compare to the
06:14:38 13 final day flow rate that was shown in that brown on your plot
06:14:42 14 that you were --
06:14:42 15 A. It would be about it.
06:14:44 16 Q. Last question for you, Dr. Gringarten, is that you were
06:14:49 17 shown a table of probabilistic range of numbers for total
06:15:01 18 compressibility. Do you remember that?
06:15:02 19 A. Yes.
06:15:02 20 Q. The numbers went from something like 15 to 20 microsips,
06:15:07 21 as I read it?
06:15:09 22 A. Yes, something like that is correct, yes.
06:15:10 23 Q. Is that number referring to rock compressibility?
06:15:16 24 A. I think.
06:15:18 25 Q. I'll refer you now to the total compressibility numbers

06:15:23 1 that were on that table.

06:15:24 2 A. Yeah. I mean, the total compressibility is the weighted
06:15:30 3 sum of the compressibility of oil and water weighted with the
06:15:52 4 saturation of oil and water, plus the compressibility of the
06:15:56 5 rock.

06:15:58 6 So in the uncertainty analysis, I have taken into
06:16:01 7 account all of the uncertainty among the elements, and I end up
06:16:07 8 with an uncertainty of the total compressibility, because the
06:16:11 9 numbers you cited were, you know, for the total
06:16:14 10 compressibility.

06:16:14 11 Q. That's an addition of rock compressibility plus water
06:16:19 12 compressibility plus oil compressibility?

06:16:22 13 A. That's correct.

06:16:22 14 Q. Do you know what the largest contributor is to that total
06:16:26 15 of what's in the range between 15 and 20 microsips on that
06:16:26 16 chart?

06:16:29 17 A. Well, it's the oil permeability -- this is the
06:16:34 18 compressibility, sorry.

06:16:34 19 Q. You said you got your rock compressibility number from
06:16:37 20 Dr. Zimmerman, correct?

06:16:38 21 A. That's correct.

06:16:38 22 Q. That's the number you believe is the correct one to use in
06:16:42 23 your analysis?

06:16:43 24 A. I have no reason to -- not to believe that.

06:16:50 25 MR. BOLES: That's all I have. Thank you.

06:16:51 1 THE COURT: You're done. Thank you, sir.

06:16:52 2 THE WITNESS: Thank you very much.

06:16:52 3 THE COURT: All right. We're going to recess until the
06:16:55 4 morning. Have we lined up our witnesses for tomorrow,
06:16:55 5 Mr. Brock?

06:17:02 6 MR. BROCK: Yes. Is court tomorrow 8:00 to 12:00?

06:17:05 7 THE COURT: Yes, I have to recess at 12:00. I have an
06:17:09 8 en banc meeting that's going to last all afternoon.

06:17:12 9 MR. BROCK: So we should be able to do Mr. Merrill, who
06:17:16 10 is a fact witness, and Dr. Zaldivar, who is an expert, tomorrow
06:17:20 11 morning.

06:17:22 12 I'm very optimistic that we would be able to
06:17:24 13 cover Dr. Momber, Dr. Nesic and Dr. Johnson on Thursday. I'll
06:17:30 14 need to get this evening a list of the US experts and the order
06:17:35 15 for Friday.

06:17:36 16 THE COURT: Mr. Merrill is testifying as a fact
06:17:39 17 witness?

06:17:40 18 MR. BROCK: As a fact witness.

06:17:43 19 THE COURT: Okay. Any other matters?

06:17:46 20 MS. HIMMELHOCH: Your Honor, we'll need to discuss
06:17:48 21 amongst ourselves the order of rebuttal witnesses. At this
06:17:51 22 time, we do intend to call all three. We believe they can
06:17:54 23 easily be completed on Friday, so we'll all be facing all three
06:17:58 24 on Friday, if they conclude on Thursday.

06:18:03 25 MR. BROCK: We would like to know the order in case we

06:18:05 1 slip into Friday morning with our case.

06:18:06 2 THE COURT: Can you let them know by this evening, or
06:18:10 3 tomorrow at the latest?

06:18:12 4 MS. HIMMELHOCH: Can I have until 8:00 a.m. tomorrow
06:18:16 5 morning, and we'll advise the Court first thing tomorrow
06:18:16 6 morning?

06:18:20 7 THE COURT: Okay.

06:18:20 8 MR. BROCK: It would be helpful for us to know that
06:18:23 9 tonight. I let them know this this morning. I'd ask to know
06:18:23 10 tonight. That's what we've been doing.

06:18:25 11 THE COURT: The order of the possible rebuttal?

06:18:27 12 MR. BROCK: The order of witnesses, yes.

06:18:28 13 THE COURT: Can you let them know sometime this
06:18:30 14 evening?

06:18:30 15 MS. HIMMELHOCH: We'll let them know by 9:00 p.m.
06:18:34 16 tonight.

06:18:34 17 THE COURT: Okay, thank you.

06:18:35 18 Anything else? All right. Everyone, have a good
06:18:37 19 evening. We'll see you at 8:00 a.m.

06:18:40 20 THE DEPUTY CLERK: All rise.

21 (WHEREUPON, at 6:18 p.m., the Court was in
22 recess.)

23 * * *

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REPORTER'S CERTIFICATE

1
2
3 I, Cathy Pepper, Certified Realtime Reporter, Registered
4 Merit Reporter, Certified Court Reporter of the State of
5 Louisiana, Official Court Reporter for the United States
6 District Court, Eastern District of Louisiana, do hereby
7 certify that the foregoing is a true and correct transcript to
8 the best of my ability and understanding from the record of the
9 proceedings in the above-entitled and numbered matter.

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<p>•</p> <p>'49 [1] - 2524:19 '50s [1] - 2524:19 '51 [1] - 2524:20 '70s [1] - 2524:21</p> <p>0</p> <p>0 [1] - 2597:19 0.87 [1] - 2615:4 02 [2] - 2592:23, 2593:6</p> <p>1</p> <p>1 [16] - 2461:15, 2467:15, 2467:16, 2478:13, 2483:4, 2483:17, 2484:19, 2552:22, 2552:25, 2553:18, 2554:8, 2554:10, 2591:19, 2605:18, 2619:21 1,161 [1] - 2599:15 1-9 [1] - 2526:7 1.1 [1] - 2483:8 1.25 [1] - 2483:8 1/3 [1] - 2591:19 10 [4] - 2502:2, 2529:25, 2596:25, 2597:12 10,000 [1] - 2601:4 10-CV-2771 [1] - 2436:7 10-CV-4536 [1] - 2436:10 100 [4] - 2470:5, 2580:20, 2601:21, 2610:22 10003 [1] - 2437:8 1001 [1] - 2440:10 11 [1] - 2478:12 110 [2] - 2490:3, 2596:22 110,000 [2] - 2550:17, 2550:19 1100 [1] - 2440:7 11505.3.1.US [1] - 2478:13 116 [2] - 2609:21, 2609:24 117 [2] - 2609:21, 2609:24 12 [26] - 2455:6, 2455:11, 2455:12, 2455:15, 2455:25, 2456:2, 2456:14,</p>	<p>2456:18, 2457:3, 2457:14, 2457:20, 2457:23, 2476:22, 2477:1, 2477:4, 2491:7, 2491:11, 2491:15, 2492:16, 2492:21, 2492:23, 2493:2, 2493:13, 2500:5, 2500:20, 2528:4</p> <p>1200 [1] - 2601:5 1201 [2] - 2439:23, 2440:23 12:00 [2] - 2627:6, 2627:7 12th [10] - 2513:6, 2515:12, 2527:5, 2533:16, 2561:6, 2623:1, 2623:12, 2623:17, 2623:22 13 [3] - 2523:13, 2523:21, 2611:10 13.7 [1] - 2485:11 1300 [1] - 2441:10 130529 [1] - 2576:15 1331 [1] - 2441:4 13th [1] - 2544:12 14 [3] - 2461:13, 2464:16, 2504:18 14.6 [1] - 2485:11 14271 [1] - 2438:15 144 [1] - 2597:15 15 [4] - 2436:5, 2444:2, 2625:20, 2626:15 15-minute [1] - 2502:2 15th [5] - 2527:6, 2538:5, 2542:21, 2566:7, 2586:11 16 [2] - 2472:18, 2473:21 1615 [1] - 2441:10 1665 [1] - 2441:4 17 [1] - 2464:14 17.84 [1] - 2584:2 170 [2] - 2529:21, 2529:22 1700 [1] - 2440:23 18 [5] - 2461:13, 2500:20, 2583:13, 2583:16, 2584:6 18.62 [1] - 2584:2 1851 [1] - 2511:21 188 [1] - 2437:18 1885 [1] - 2438:5 19 [5] - 2526:5, 2526:6, 2526:9, 2583:13, 2583:17 1973 [1] - 2497:23 1978 [1] - 2506:5</p>	<p>1983 [2] - 2506:20, 2519:20 1984 [2] - 2462:3, 2462:15</p> <p>2</p> <p>2 [9] - 2482:24, 2484:19, 2545:20, 2552:22, 2553:3, 2553:19, 2554:8, 2554:13, 2619:22 2-inch [1] - 2483:18 2.4 [3] - 2510:2, 2546:7, 2576:1 2.49 [1] - 2553:18 2.5 [2] - 2545:9, 2545:16 2.7 [1] - 2622:20 2.9 [1] - 2575:25 20 [17] - 2436:5, 2461:12, 2461:13, 2490:2, 2520:25, 2536:4, 2591:13, 2591:18, 2601:10, 2602:11, 2602:21, 2604:2, 2604:3, 2608:4, 2625:11, 2625:20, 2626:15 2000 [2] - 2525:23, 2536:3 20004 [1] - 2439:24 20005 [1] - 2439:20 20006 [1] - 2441:14 2001 [3] - 2508:18, 2525:23, 2536:3 2002 [1] - 2508:18 2003 [1] - 2463:6 20044 [2] - 2438:15, 2438:24 2006 [1] - 2508:19 2007 [1] - 2478:12 2009 [2] - 2469:18, 2472:15 2010 [7] - 2436:5, 2456:17, 2471:22, 2477:17, 2499:10, 2528:4, 2610:6 2011 [2] - 2576:17, 2577:25 2013 [2] - 2436:5, 2444:2 2020 [1] - 2441:14 205 [1] - 2599:14 20th [3] - 2544:12, 2564:2, 2567:4 21 [3] - 2461:15, 2522:2, 2566:25 22 [2] - 2469:18,</p>	<p>2600:11 220 [1] - 2566:24 2216 [1] - 2437:11 23 [1] - 2615:8 238 [8] - 2510:1, 2529:18, 2544:5, 2544:21, 2546:6, 2599:14, 2599:15, 2622:19 24 [1] - 2464:17 240 [1] - 2490:5 2400 [1] - 2601:6 2444 [2] - 2442:5, 2442:6 2458 [1] - 2442:7 249 [2] - 2599:14, 2599:15 25 [3] - 2504:4, 2520:25, 2521:2 250 [6] - 2611:15, 2611:24, 2612:13, 2612:25, 2613:15, 2614:1 2502 [1] - 2442:8 2503 [1] - 2442:9 2508 [1] - 2442:10 2509 [1] - 2442:19 2551 [1] - 2442:11 26 [1] - 2472:15 2613 [1] - 2442:12 27 [8] - 2473:14, 2473:18, 2474:5, 2475:1, 2603:19, 2604:8, 2604:22, 2615:7 28 [5] - 2603:19, 2604:8, 2604:10, 2604:23, 2604:24 280 [1] - 2609:21 281 [3] - 2544:22, 2615:20, 2616:2 281.9 [3] - 2597:16, 2597:20, 2598:13 292 [6] - 2596:19, 2597:7, 2597:23, 2598:16, 2615:20, 2616:2 2:48 [1] - 2502:4</p> <p>3</p> <p>3 [5] - 2484:19, 2510:2, 2545:17, 2546:7, 2576:1 3.0 [1] - 2553:19 3.26 [1] - 2576:3 3.3 [1] - 2546:11 3.7 [1] - 2575:25 30 [3] - 2495:8,</p>	<p>2521:4, 2521:11 30,000 [2] - 2553:3, 2621:18 300 [2] - 2439:12, 2614:11 316 [1] - 2437:4 31st [1] - 2553:3 320 [1] - 2530:12 32502 [1] - 2437:5 329 [2] - 2530:1, 2530:10 33 [1] - 2464:16 333 [1] - 2439:15 335 [1] - 2440:16 35 [5] - 2473:20, 2474:6, 2475:2, 2547:19, 2610:15 35TH [1] - 2440:16 36 [1] - 2534:1 360 [1] - 2532:16 36130 [1] - 2437:23 3668 [1] - 2436:24 37.1.US [1] - 2558:23 3700 [2] - 2440:7, 2440:10 377 [2] - 2463:10 39201 [1] - 2437:19</p> <p>4</p> <p>4 [2] - 2542:9, 2591:22 40 [7] - 2535:11, 2607:25, 2608:5, 2608:7, 2608:23, 2608:24 42,400 [2] - 2568:17, 2569:9 44 [2] - 2467:14, 2540:21 45,000 [9] - 2544:19, 2545:12, 2546:1, 2546:9, 2546:10, 2552:25, 2553:4, 2621:15, 2621:19 45-degree [1] - 2484:7 46 [1] - 2538:6 47 [1] - 2543:5 48 [1] - 2545:6 48,000 [1] - 2568:10 49 [1] - 2545:18</p> <p>5</p> <p>5,000 [1] - 2467:24 50 [1] - 2557:19 500 [9] - 2436:23, 2437:23, 2441:18, 2611:15, 2611:24,</p>
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